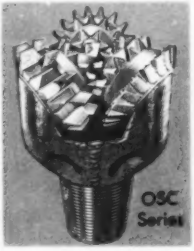
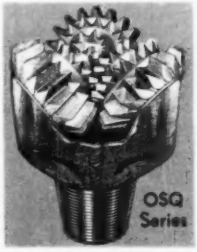
DRILLING
Contractors and Equipment
Number

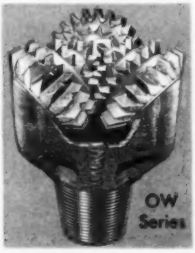
L AND GAS URNAL

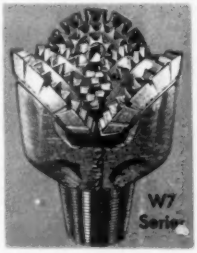
Whatever your rock bit problem **HUGHES HAS THE ANSWER!**

HUGHES
TOOL COMPANY
HOUSTON, TEXAS
WORLD STANDARD
OF THE INDUSTRY









From grass roots to total depth, there is a specially designed Hughes Rock Bit for each formation . . . your assurance of fast, full-gage, straight hole . . . an "Engineered Solution" for your every drilling problem.

PRICE 50 CENTS TABLE OF CONTENTS PAGE 131 **SEPTEMBER 22, 1949**

Now available

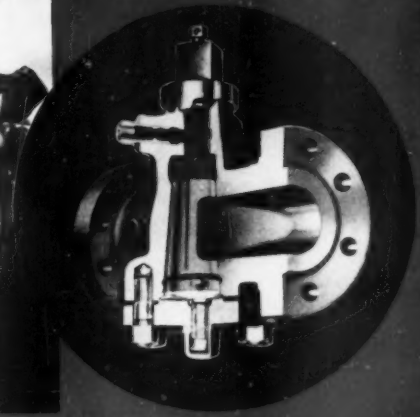
NORDSTROM CHRISTMAS TREE VALVES

STAINLESS STEEL

of the 12-14% Chromium type

KEEP UPKEEP DOWN

For highly corrosive conditions in Christmas trees and for handling abrasive fluids Nordstrom lubricated valves may be obtained with stainless steel connections. Offering the unsurpassable combination of a lubricated tapered plug with unexposed seat and stainless steel with hardest properties, Nordstrom valves are most economical. Use them; Compare their service.



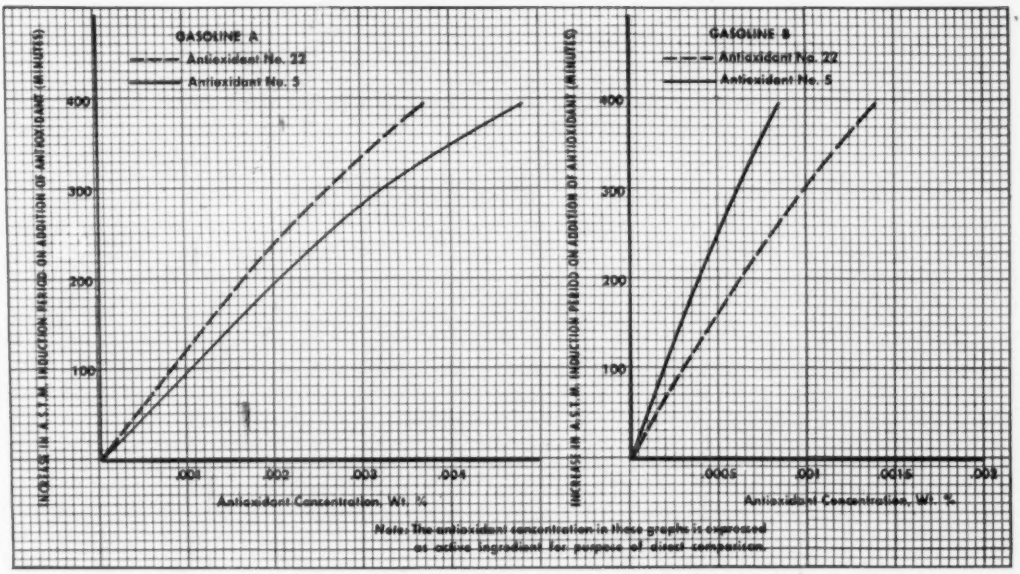
Nordstrom

LUBRICATED VALVES FOR CHRISTMAS TREES

NORDSTROM VALVE DIVISION—ROCKWELL MANUFACTURING COMPANY

400 North Lexington Avenue • Pittsburgh 8, Pennsylvania

Atlanta, Boston, Chicago, Columbus, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco, Seattle, Tulsa . . . and leading Supply Houses • Exports: Rockwell Manufacturing Company, International Division, 7701 Empire State Building, New York 1, New York



For Lowest Gasoline Treating Costs... Check All 3 Du Pont Gasoline Antioxidants

Not all gasolines respond alike to antioxidants. That is why Du Pont offers three gasoline antioxidants . . . Nos. 5, 6 and 22, from which you can choose the one best suited to your gasoline.

The accompanying graphs, taken from our laboratory files, show how in two gasoline stocks there was an entirely different response to Antioxidants Nos. 5 and 22. In Gasoline "A", Antioxidant No. 22 showed a marked saving over No. 5, and in Gasoline "B" the response was reversed with No. 5 showing a definite advantage over No. 22. (No. 6 had approximately the same response as No. 5, but in some other stocks has proven more economical than either No. 5 or No. 22).

No matter what type of antioxidant you may be using, a periodic check with these three Du Pont antioxidants may help you lower your gasoline treating costs, especially if there are changes in crude supply or refining processes.

Samples are available, or the nearest Du Pont District Laboratory will gladly assist you in evaluating your fuel and in making the proper recommendations. For further information, ask your Petroleum Chemicals representative or write the nearest District Office.

Du Pont Antioxidant No. 5—is a solution containing 50% Normal-butyl-para-aminophenol, 30% Anhydrous iso-propanol, and 20% Anhyrous methanol.

Du Pont Antioxidant No. 6—is a solution containing 50% Iso-butyl-para-aminophenol, 30% Anhydrous iso-propanol, and 20% Anhydrous methanol.

Du Pont Antioxidant No. 22—is a commercial grade of N,N' disecondary butyl-para-phenylene-diamine containing no solvents.

DU PONT
PETROLEUM CHEMICALS

DU PONT
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

E. I. DU PONT DE NEMOURS & CO., (INC.)
Petroleum Chemicals Division • Wilmington 98, Delaware

District Offices: Wilmington, Del.; Chicago, Ill.; Tulsa, Okla.; Houston, Texas; Los Angeles, Calif.

District Laboratories: Wilmington, Del.; Chicago, Ill.; Tulsa, Okla.; Houston, Texas; El Monte, Calif.

Rugged

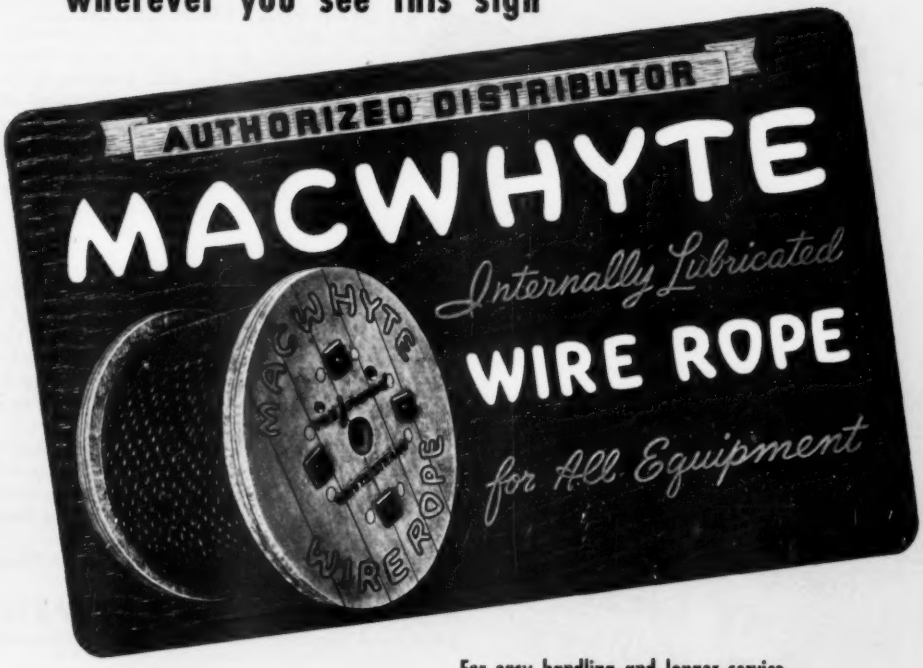
Fairbanks-Morse 8 cover side pot fluid end power pumps are rugged . . . built for lasting service. Add to this, the self-oiling power end and maximum accessibility for inspection and servicing, and it's easy to see why these power pumps are so widely preferred in the field. Pumps are readily adaptable for pumping water, slush, or petroleum products. Fairbanks, Morse & Co., Chicago 5, Ill.

FAIRBANKS-MORSE

A name worth remembering

OIL FIELD EQUIPMENT • DIESEL LOCOMOTIVES • DIESEL ENGINES • PUMPS
SCALES • MOTORS • GENERATORS • STOKERS • RAILROAD MOTOR CARS
and STANDPIPES • FARM EQUIPMENT • MAGNETOS

You get better service wherever you see this sign



There's a *Macwhyte* Rope that's the *right* rope for your equipment. All job-proved — a thousand and one wire ropes to choose from.

Our distributors and mill depots — located at convenient points all over the country — carry stocks for immediate delivery. Ask a Macwhyte representative to recommend the rope best suited for your equipment.

MACWHYTE COMPANY
2916 Fourteenth Avenue • Kenosha, Wisconsin

Manufacturers of Internally Lubricated Wire Rope, Braided Wire Rope Slings, Aircraft Cables and Assemblies, Monel Metal and Stainless Steel Wire Rope.

Catalog on request

For easy handling and longer service

Use PREformed Whyte Strand Wire Rope—it's internally lubricated

Mill Depots: New York • Pittsburgh • Chicago • Minneapolis • Fort Worth • Portland • Seattle • San Francisco • Los Angeles

NO. 952

20,810 hours without a major overhaul...

Spike Fagans, Drilling Superintendent for W. D. Kelley says of his Murphy Diesels, *"Have had exceptionally good service out of our Murphy Diesels and still are. When we buy a new rig it also will be powered by Murphy Diesels. In oil field language, it is a hell of a good engine. When total costs are considered, I do not believe they can be beat."*

The two Murphy Diesels referred to above by Spike Fagans have drilled 61 wells with a total footage of 188,110'. Each engine has operated for 20,810 hours without a major overhaul. All the drilling has taken place in the panhandle country around Pampa and Borger, Texas.

Wherever they are used in the oil fields, Murphy Diesels are piling up impressive records for dependability and economy. Their rugged, heavy-duty construction enables them to make more hole faster, at lower cost with less down time.

Get full details from your Murphy Diesel Dealer or write direct.

MURPHY DIESEL COMPANY
5305 West Burnham St., Milwaukee 14, Wisconsin
FACTORY BRANCH — *Sales, Parts and Service:*
113-117 South Elwood Street, Tulsa, Oklahoma

for a pair of MURPHY DIESELS on W. D. Kelley's rig near Pampa

MURPHY DIESEL

Heavy duty power

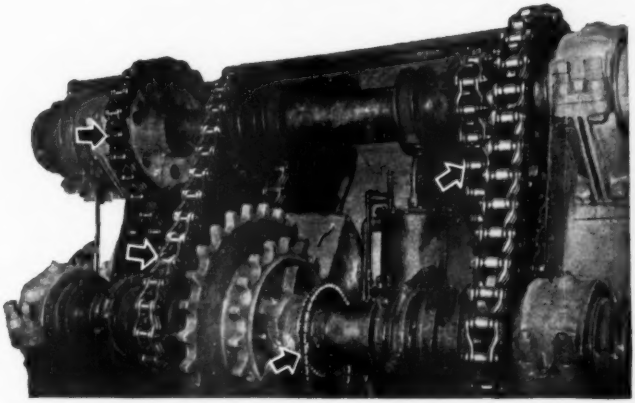
for the oilfields

Murphy Diesel Engines and Power Units for drilling and pipeline pumping, 90 to 220 H.P. Diesel-Electric generating Sets 60 to 133 K. W.

The Oil and Gas Journal, published Thursdays by The Petroleum Publishing Company. Entered as second-class matter at post office at Tulsa, Okla., under act of March 3, 1879. U. S. and foreign rates to the petroleum industry, $3 yearly. Copyright 1949.

The UNSEEN QUALITIES in LINK-BELT Chains...

longer service with less maintenance!



The many unseen qualities—as well as the obvious features you can see—contribute heavily to Link-Belt's close to 75-year reputation for "longer service with less maintenance".

Here are some unseen qualities of Link-Belt API-4 Hyper drilling chains, to which no illustrations can do justice.

SIDEBARS . . . . offset type, reinforced by rib at offset, preventing pitch distortion under extreme load—a decided advantage for rotary chains; drop forged alloy steel normalized and heat-treated for maximum strength; pin and bushing holes finished to precision limits (with pitch accurately controlled for easier assembly and longer service).

BUSHINGS . . . . machined alloy steel, case-hardened for maximum wear resistance; ground internally and externally to precision accuracy; secure fit in sidebars assures strong, rigid unit of assembled link; oil holes placed for most efficient lubrication of bearing surfaces, longer service.

PINS . . . . forged alloy steel, machined, heat-treated, precision ground and cadmium plated; large diameter pin fully utilized to provide ample bearing area and stiffness for greater strength and longer service. Pin end chamfered to facilitate assembly.

ROLLERS . . . . alloy steel, heat-treated, for maximum wear-resistance; with close tolerances for smooth, resilient, shock-absorbing operation, longer service, less maintenance.

Patented oil grooved sidebars permit free entry of oil to chain joint and bearings.

Users of Link-Belt API-4 Hyper chain will tell you these UNSEEN QUALITIES are worth remembering the next time you buy drilling chain!

LINK-BELT COMPANY

Indianapolis 6, Dallas 1, Houston 3, Los Angeles 33, Kansas City 6, Mo., New York 7, Toronto 8.
Distributors in all fields. 11,507

LINK-BELT

CHAINS AND SPROCKETS

A Type for Every OIL INDUSTRY SERVICE

ONE NAME
THREE SERVICES

CHRISTENSEN

Three vital services to the oil drilling industry from a single source

1

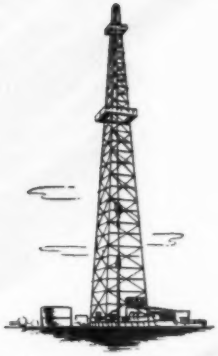
DIAMOND CORE BITS

The bits that have brought faster drilling, greater core recovery, less cost per foot.

2

CORE BARRELS

A product standard as high as Christensen diamond bits . . . barrels for rental or sale to provide a perfect team with Christensen bits.



FIELD SERVICE **3**

Wherever Christensen products are used, trained field engineers are available.

Base Points

Purcell — Hobbs — Shreveport — Casper — Worland

Complete Service
Less Cost Per Foot

LESS COST PER FOOT
CHRISTENSEN
DIAMOND PRODUCTS

CHRISTENSEN DIAMOND PRODUCTS COMPANY

1975 SOUTH 2ND WEST • PHONE 6-8738 • SALT LAKE CITY, UTAH

The HEART

IS THE MECHANICAL EQUIPMENT

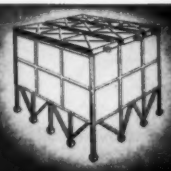
DriCooler*

DriCoolers are the only finned tube cooling units that have mechanical equipment proved in over 5,000 actual installations.

Fans, driveshafts, Geareducers and fan cylinders long used successfully on the toughest air moving job—water cooling towers—have been further improved and tailored for the DriCooler.

This new mechanical equipment with the "Made-by-Marley" label is your guarantee of "stout-hearted" air-cooled units.

Induced Draft horizontal heat transfer surface under the fan.



Forced Draft horizontal heat transfer surface over the fan.

*DriCooler is the exclusive trade-mark of The Marley Co., Inc.

MARLEY DRICOOLERS

THE MARLEY COMPANY, INC. • KANSAS CITY 15, KANSAS

WATER COOLING TOWERS • DRICOOLERS • SPRAY NOZZLES

SAVE 5 WAYS on Pipe Threads

- FEWER MACHINES
- LOWER TOOL COST
- LOWER TOOL INVENTORY
- LESS SET-UP TIME
- HIGHER PRODUCTION

In tightening markets, Landis Pipe Threading Machines offer wide-open opportunities to cut production costs of pipe threads.

Three sizes of Pipe Machines will handle all diameters of pipe from 1/4" to 18". Each die head is constructed to handle a wide range of pipe sizes —for example the 6" machine will thread all diameters from 1" to 6". Universal size adjustment allows quick set-up. Thus, a few machines will handle the complete range.

Die heads employ Landis Tangential Pipe Chasers. Interchangeability of the chasers further increases the versatility of these machines. The same chasers may be used for all diameters of threads within the range of a given die head providing that the pitch, form, and taper remain the same, thus reducing tool inventory. Chasers need be replaced only one at a time as needed. Chasers last longer since 80% of their length may be reground as the cutting edge dulls. Line contact with the work reduces friction and chaser wear, allows use of higher cutting speeds, and reduces chaser breakage.

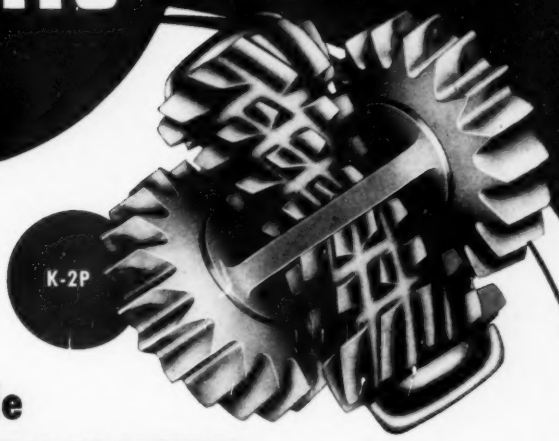
A separate type of machine, the Receding Chaser Pipe Machine, is especially designed to handle A.P.I. Tapered Pipe Threads. Chasers recede into the head at a rate equal to the taper of the thread, ensuring accurate and uniform taper along the full thread length. This mechanism allows the use of smaller chasers, lowering tool cost and dollar tool inventories. Leave-off marks are eliminated by this receding action.

Investigate how Landis Pipe Machines can reduce direct tool cost, increase daily production, and reduce investment in tool inventory and heavy machinery. Write for specifications and further information.

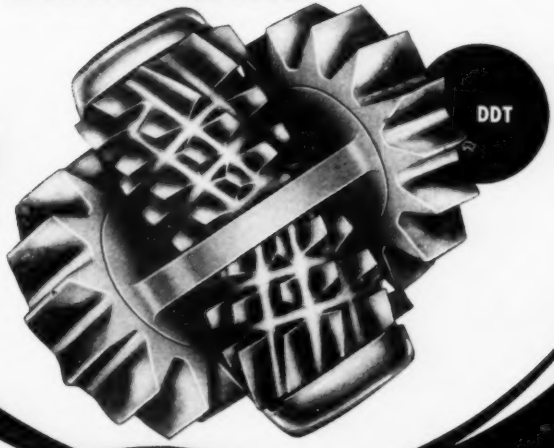
LANDIS Machine COMPANY
WAYNESBORO PENNA., U.S.A.

Represented in the Domestic Oil Fields by: Colcord-Wright Machinery & Supply Co., St. Louis, Mo.; C. J. Harter Machinery, Houston, Texas; Frederic-Baker Co., New Orleans, La.; Moore Machinery Co., Los Angeles and San Francisco, Calif.; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.

H.C. SMITH ROCK BITS



full gauge hole
FASTER-STRAIGHTER



H.C. Smith
OIL TOOL CO.

GENERAL OFFICES AND PLANT
P.O. BOX 431, COMPTON, CALIF.

To cut the cost of cylindrical parts . . .

here's the place to start

LOOKING for new ways to reduce costs? You can simplify manufacture and save material by using Timken® seamless tubing instead of bar stock for your hollow or ring-shaped parts. With Timken seamless tubing, you start with the hole already there. Finish boring is often your first production step. There's less stock to machine—less scrap loss. Elimination of drills on automatic machines often leaves space for other tools, sometimes almost doubling output.

Because the piercing process by which Timken tubing is made is basically a forging operation, you get added strength for your product as well as lower cost. The tube is thoroughly hot worked during piercing which results in a *uniform grain flow* for great strength, and a *refined grain structure* to bring out the best in the quality of the metal. This fine forged quality of Timken seamless tubing is always uniform. Timken's rigid quality control from melt shop through final inspection assures you of uniformity from tube to tube and heat to heat—and uniform response to your machining and heat treating operations.

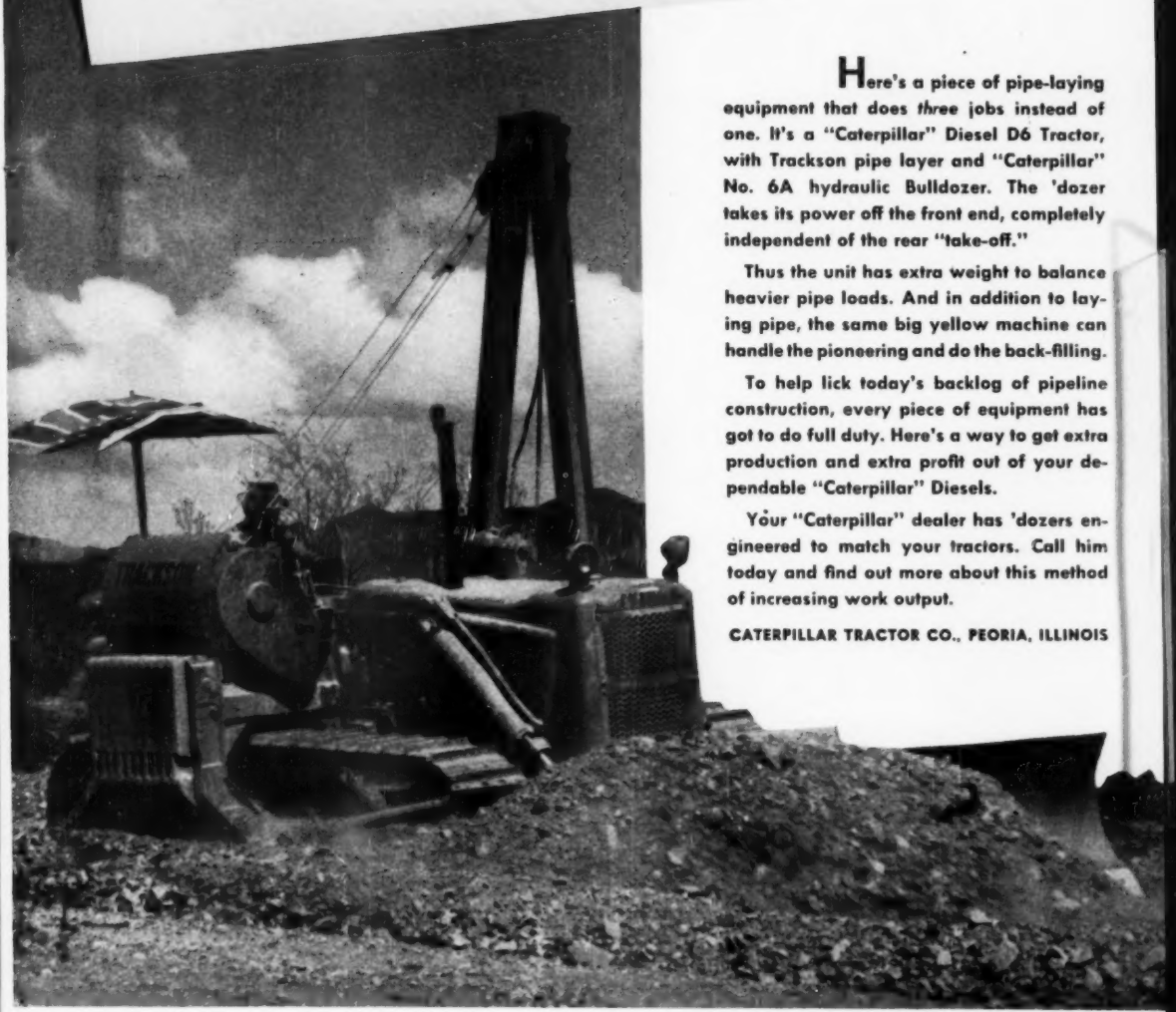
TIMKEN TUBE ENGINEERING SERVICE OFFERS *EXTRA* SAVINGS!

To get the most economical size tube for your job, guaranteed to clean up, use our Tube Engineering Service. With the tubing they specify, you waste no time or material machining away excessive stock. Yet you're sure you have *enough* metal to fill out your dimensions. Write today for an analysis of your requirements, without obligation. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

50th birthday of the company whose products you know by the trade-mark: TIMKEN

Specialists in alloy steel—including hot rolled and cold finished alloy steel bars—a complete range of stainless, graphitic and standard tool analyses—and alloy and stainless seamless steel tubing.

TRIPLE-ACTION MONEY-MAKER



Here's a piece of pipe-laying equipment that does *three* jobs instead of one. It's a "Caterpillar" Diesel D6 Tractor, with Trackson pipe layer and "Caterpillar" No. 6A hydraulic Bulldozer. The 'dozer takes its power off the front end, completely independent of the rear "take-off."

Thus the unit has extra weight to balance heavier pipe loads. And in addition to laying pipe, the same big yellow machine can handle the pioneering and do the back-filling.

To help lick today's backlog of pipeline construction, every piece of equipment has got to do full duty. Here's a way to get extra production and extra profit out of your dependable "Caterpillar" Diesels.

Your "Caterpillar" dealer has 'dozers engineered to match your tractors. Call him today and find out more about this method of increasing work output.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

This "Caterpillar" D6 Tractor, equipped with Trackson pipe layer and "Caterpillar" No. 6A hydraulic Bulldozer, is owned by California Pipeline Construction Co., Gardena, Calif. Here shown back-filling trench after laying pipe.

CATERPILLAR

REG. U. S. PAT. OFF.

WHEN YOU THINK OF PIPELINE WORK, THINK OF THE BIG YELLOW MACHINES THAT DO IT BEST

DIESEL ENGINES
TRACTORS
MOTOR GRADERS
EARTHMOVING EQUIPMENT

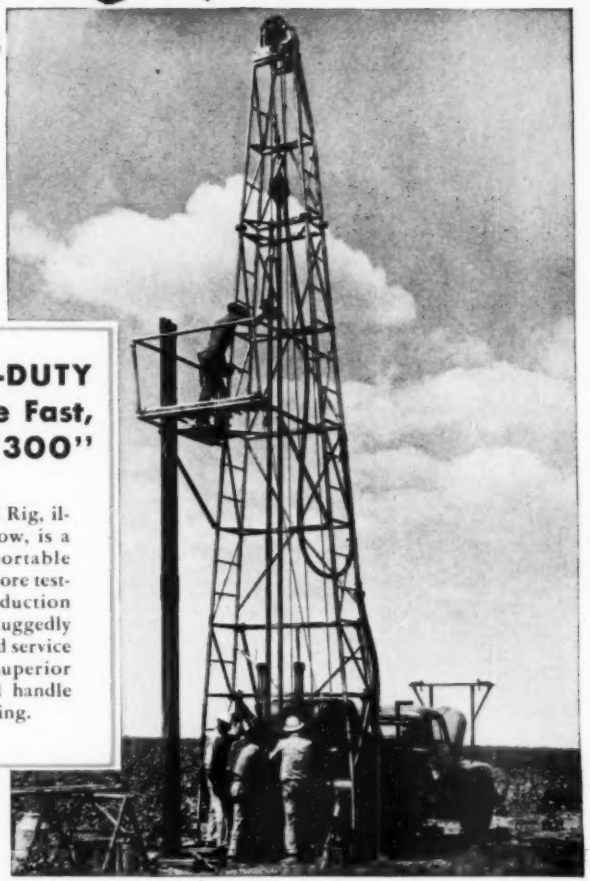
JOY MOTORIZED RIGS

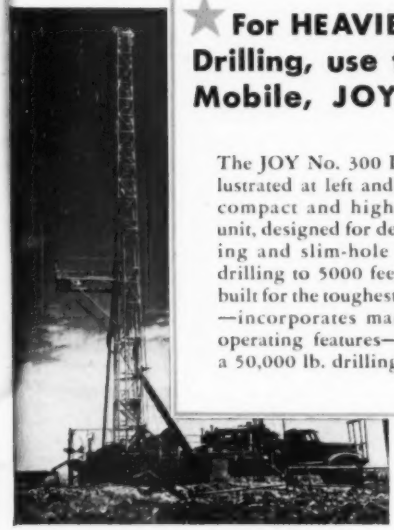
Meet any drilling requirement

★ The NEW "150" DRILL RIG

Latest Design—Top Performance!

The JOY "150" (*right*) is designed for heavy-duty seismograph, electrical logging, structure testing and shallow water well drilling to 1500 feet. It incorporates the most modern improvements in drill rig design . . . has *proved* itself outstanding in the field within its capacity range.





★ For HEAVIER-DUTY Drilling, use the Fast, Mobile, JOY "300"

The JOY No. 300 Drill Rig, illustrated at left and below, is a compact and highly portable unit, designed for deep core testing and slim-hole production drilling to 5000 feet. Ruggedly built for the toughest field service—incorporates many superior operating features—will handle a 50,000 lb. drilling string.

★ INTERMEDIATE SIZES FOR EVERY NEED—THE JOY 225, 250 and 275 DRILL RIGS

Write for Bulletins, or

Consult a Joy Engineer

W & O 02364

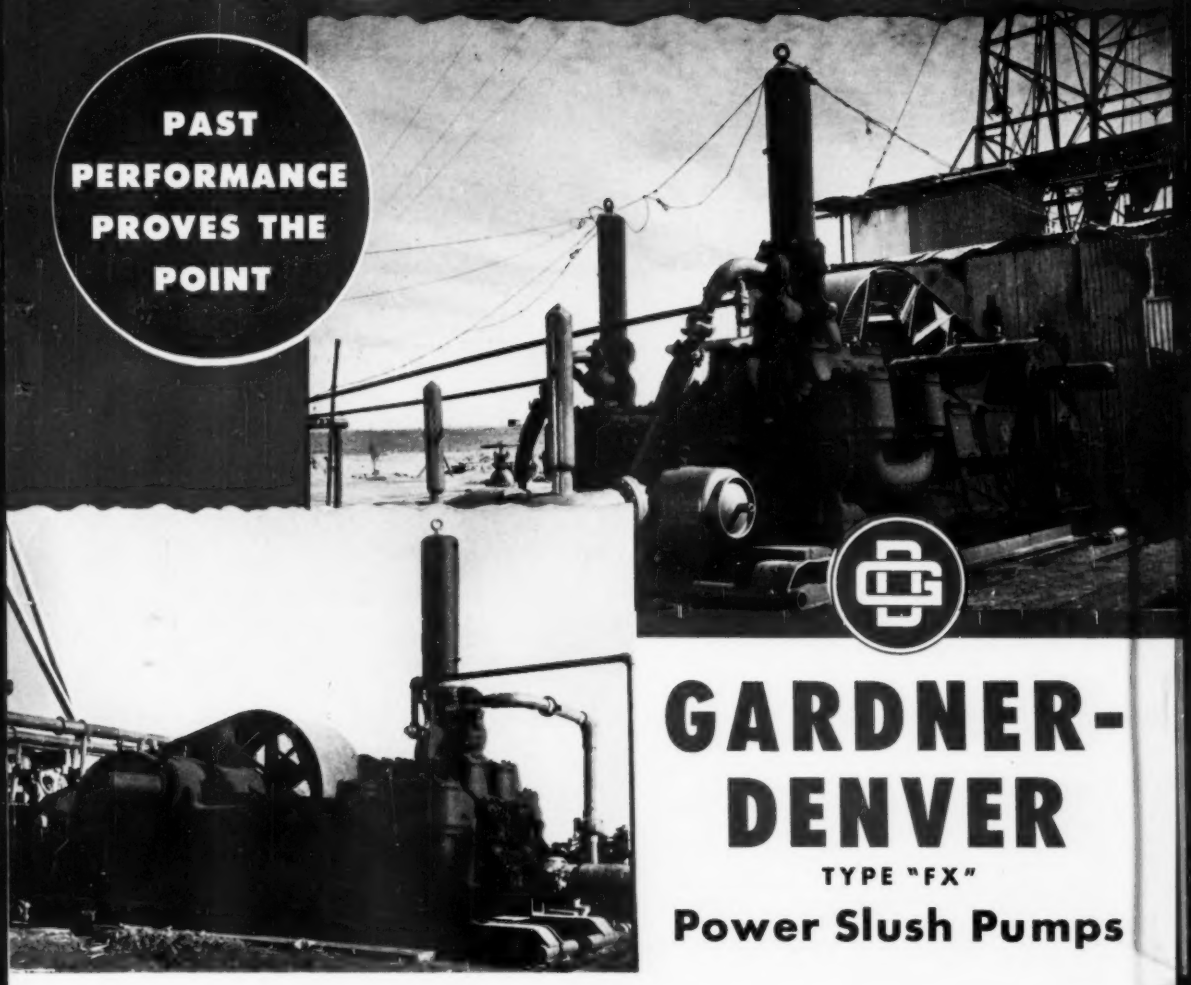
JOY MANUFACTURING COMPANY

GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.

IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LIMITED, GALT, ONTARIO

RUGGED!

PAST PERFORMANCE PROVES THE POINT



GARDNER-DENVER

TYPE "FX"

Power Slush Pumps

- Continuous tooth-type Herringbone gear of GarDurloy mixture. Exclusive Gardner-Denver eccentric construction provides large bearing area for connecting rods—*protects against overloads.*
- Divided fluid cylinder construction of GarDurloy alloy. Oil-stop and mud-stop heads—*positively protect against contamination of lubricant in power end.*
- One-piece main frame with reinforced ribs, cast of durable GarDurloy alloy mixture—*protects against shock.*

Ask a Continental Man for complete details

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Export Division: 30 Rockefeller Plaza, New York, N. Y.

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Here are just a FEW of the reasons why this

Beechcraft

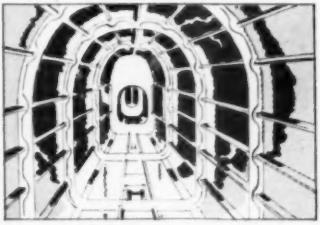
BONANZA is a better buy!

Ruggedness plus Speed . . . Performance plus Economy . . . Beauty plus Power

The Beechcraft Bonanza's high payload, high speed, and low operating cost, combined with extra safety and greater comfort, make this Beechcraft a better buy! It's easy to enter or leave the 4-place Beechcraft Bonanza with its unique retractable step and wide auto-type door. Plenty of room for four big people to ride in uncrowded comfort. Maximum 5-way visibility and sound-proofing of the smartly appointed cabin add to the limousine luxury of this outstanding airplane.

High Performance—At 8000 feet the Beechcraft Bonanza cruises at 170 mph using only 56% of the engine's maximum rated take-off power. *No engine overload*, so you get extra speed with an extra margin of safety. Take a look at the Beechcraft list of guaranteed performance figures for the Bonanza.

...Plus Economy—Because of lack of engine overload you get lower maintenance costs and longer service life. Beechcraft Bonanza travel means you get an *extra low* per mile operating cost, an *extra low* fuel consumption of 9½ gallons per hour at cruising speed. You *save*, with a Beechcraft Bonanza.



...Plus Safety—Extra ruggedness of the sturdy framework means an extra margin of safety. Rated in the *utility* category at *full gross weight*, with a limit flight load factor of 4.4 G's, the Beechcraft A35 Bonanza has been subjected to dive tests by radio control at 275 miles per hour and pulled out safely at 3 G's.

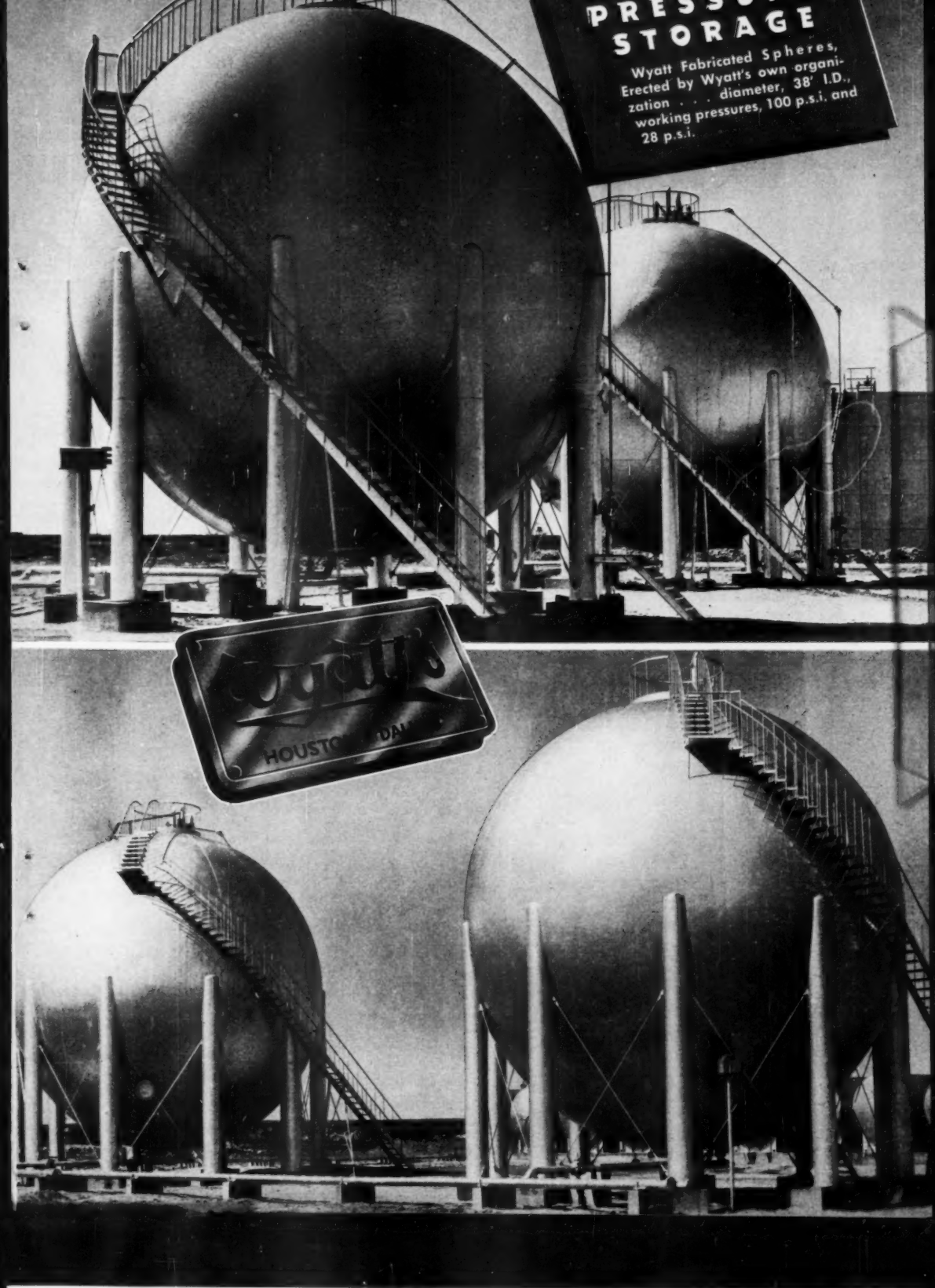
Compare these performance features	Compare these comfort features
Top speed, 184 mph	Exclusive retractable step
Cruising speed, 170 mph	Limousine entrance
Range, 750 miles	Insulated, sound-proofed cabin
Service Ceiling, 17,100 feet	Quickly removable rear seat
Fuel economy, 9½ gal. per hour	Luggage compartment accessible two ways

These are only a few of the reasons why the Beechcraft Bonanza is a better buy! *See* it today! A note on your company letterhead will bring illustrated brochures describing the Beechcraft Bonanza's many *extra* advantages. Write to Beech Aircraft Corporation, Wichita, Kansas, U.S.A.

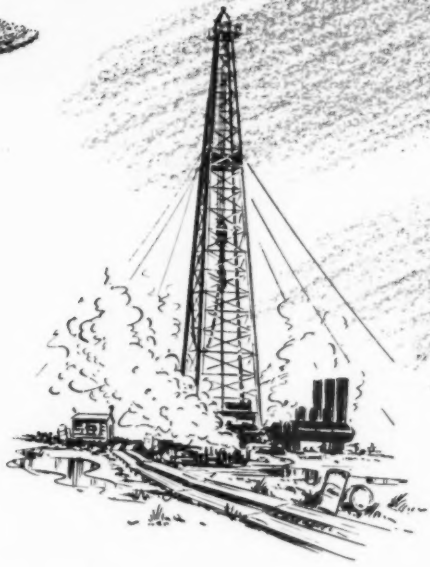
Beechcraft

BONANZA MODEL A35

BEECHCRAFTS ARE THE AIR FLEET OF AMERICAN BUSINESS


PRESSURE
STORAGE
Wyatt Fabricated Spheres, Erected by Wyatt's own organization . . . diameter, 38' I.D., working pressures, 100 p.s.i. and 28 p.s.i.
Wyatt's
HOUSTON, TEXAS

to the man of Hard Work



Vision, and Accomplishment... *the Drilling Contractor*

The 22-billion-dollar Petroleum Industry is the world's fastest growing business. In its 90-year history it has never slowed its pace. Today it furnishes 48% of the world's total energy.

Such accomplishment was not accidental. The road was not smooth. This industry gained its place by vision, study, planning, hard work.

Giving credit where credit is due puts a high percentage of Petroleum Industry success on the head and shoulders of the Drilling Contractor. Most of the Industry's 2,000 contractors are men who "got their's the hard way." Few of them started with little more than a knowledge of hard work and the willingness to do it. They didn't look back at failure; nor were they spoiled by success. Much of America's production is owned by Drilling Contractors . . . results of their own findings. Today they drill 80% of the nation's wells. Many large oil companies were formed by Contractors who planted the seed, nurtured the operation, guided the destiny.

We, at Republic Supply, have had the privilege of knowing these men and serving them for more than a third of a century. It is a pleasure to pay them the high tribute they so justly deserve.

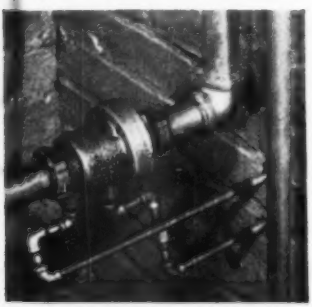
Republic Supply
COMPANY
GENERAL OFFICES · · · HOUSTON 1, TEXAS

YOUR SUPPLY STORE

IN OILFIELD SERVICES

the FLEXFLO NEVER FAILS

In this automatic differential-controlled shut-off installation, the Flexflo itself is buried several feet below ground level, with only the controls accessible . . . proof positive of Flexflo dependability.



On this automatic sprinkler control service, the Flexflo is isolated behind a fire-wall, the solenoid operator within reach on the other side.

CAN'T STICK — CAN'T SLAM — CAN'T WEDGE OPEN

When you're looking for reliability—when you want a valve that gives continuous trouble-free service under the toughest of working conditions, there's no need to look further . . . Grove Flexflo surpasses every expectation. Its great sensitivity and smooth instantaneous response enable it to react to the slightest change in control pressure. With the Flexflo, you can handle line pressures up to 1000 p.s.i. It resists the abrasive action of sand-laden gas and oil and is entirely self-compensating for the slightest degree of wear. What's more, there are no metallic moving parts to corrode or cause the troubles commonly encountered in conventional type valves. You merely install it and forget it from then on. No maintenance is required, no time-wasting shutdowns . . . the Flexflo always does its job without fail.

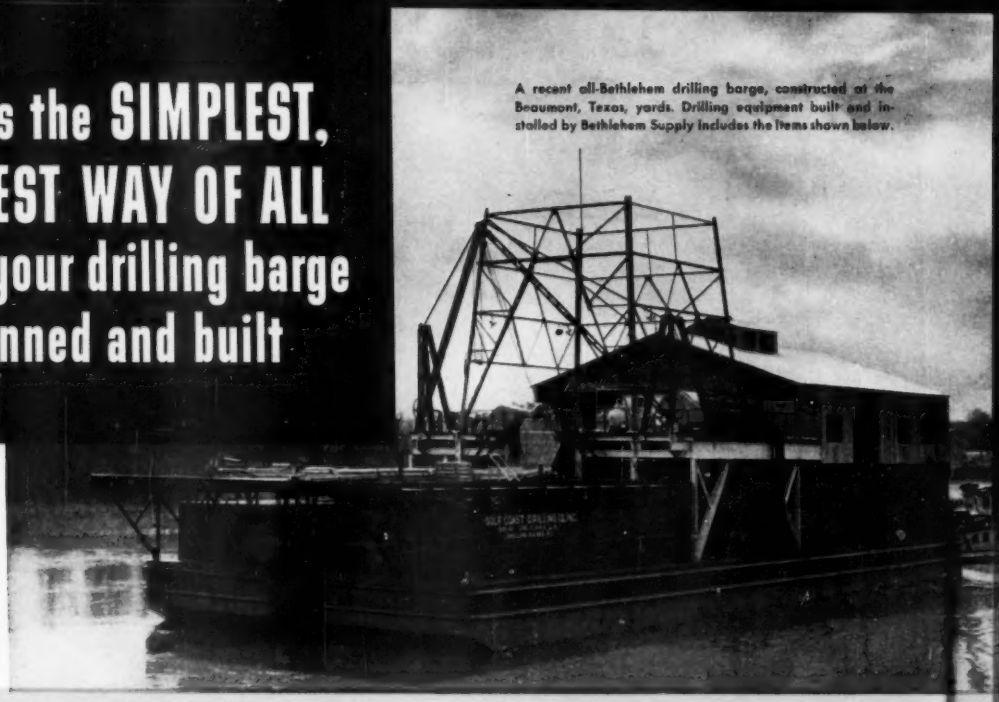
Make the Grove Flexflo your choice for unending service and unfailing performance. Write for the full details, today.

GROVE REGULATOR COMPANY
65th & Hollis Street Oakland 8, Calif.

Factory Branches: 3608 Navigation Blvd., Houston, Texas; 1930 W. Olympic Blvd., Los Angeles 6, Calif.

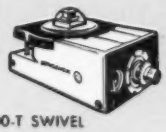
GROVE — FLEXFLO "PUTS PRESSURE TO WORK" — REMOTE CONTROL VALVE

Here's the SIMPLEST, EASIEST WAY OF ALL to get your drilling barge planned and built

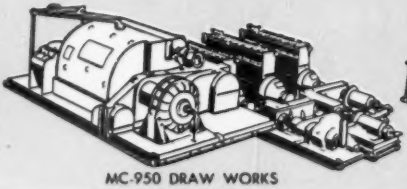


A recent all-Bethlehem drilling barge, constructed at the Beaumont, Texas, yards. Drilling equipment built and installed by Bethlehem Supply includes the items shown below.

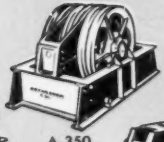
300-T SWIVEL



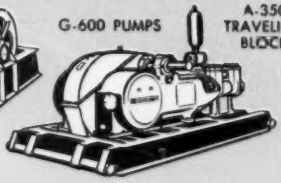
B-21-S ROTARY TABLE



MC-950 DRAW WORKS



A-350 CROWN BLOCK



G-600 PUMPS

A-350 TRAVELING BLOCK

You start it by saying to Bethlehem, ***"Here's what we want. Take over. Build us the barge, furnish the drilling equipment and everything else. Then, when it's finished, deliver it ready for work."***

Right there, you put the responsibility on our shoulders—*all* the responsibility. You eliminate the headaches, complications, and mixups that would come from dealing with ten or a dozen companies on the same job. You get Bethlehem's years of experience in barge-building; the finest of drilling equipment from Bethlehem Supply; the advantages of a unified, highly co-ordinated engineering staff; the services of a purchasing division that knows *how* to buy, *what* to buy, and *where* to buy for marine equipment.

When we deliver your all-Bethlehem barge, it will be ready to go, ready for its first drilling job. It will come to you all piped up—pumps, mud system, everything. Even the lower parts of the derrick will be in place, with due allowance for bridge clearance.

This is a building and equipping service that completely relieves the customer of all worries. Bethlehem does the job—the *whole* job. Why not investigate the numerous advantages of our methods and facilities? An inquiry will start the ball rolling.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

Shipbuilding Division

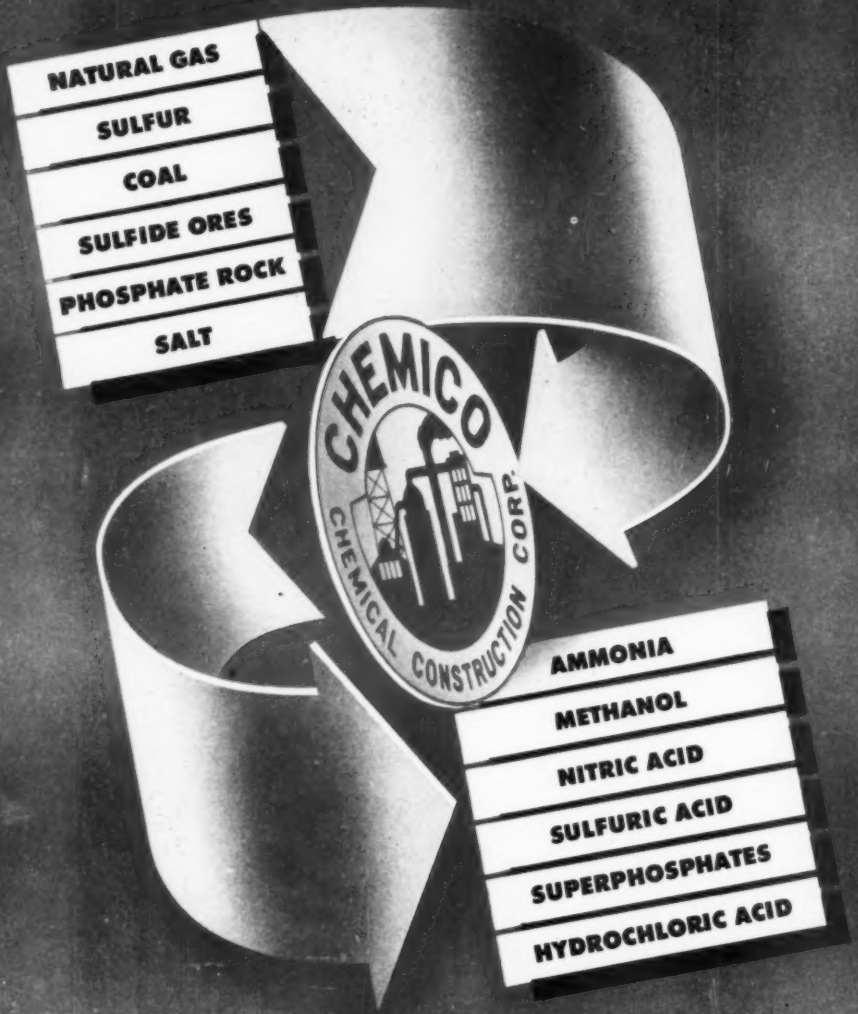
GULF COAST YARDS: BEAUMONT, TEXAS

BETHLEHEM SUPPLY COMPANY

GENERAL OFFICES: 21 E. SECOND ST., TULSA, OKLA.

Subsidiaries of Bethlehem Steel Corporation

TO PRODUCE HEAVY CHEMICALS AT A PROFIT!



CHEMICAL CONSTRUCTION CORPORATION

CONTRACTING CHEMICAL ENGINEERS

EMPIRE STATE BLDG., 350 FIFTH AVENUE, NEW YORK 1, N.Y.

EUROPEAN TECHNICAL REPRESENTATIVE CYANAMID PRODUCTS, LTD., BRETTENHAM HOUSE, LANCASTER PLACE, LONDON W.C.2, ENGLAND

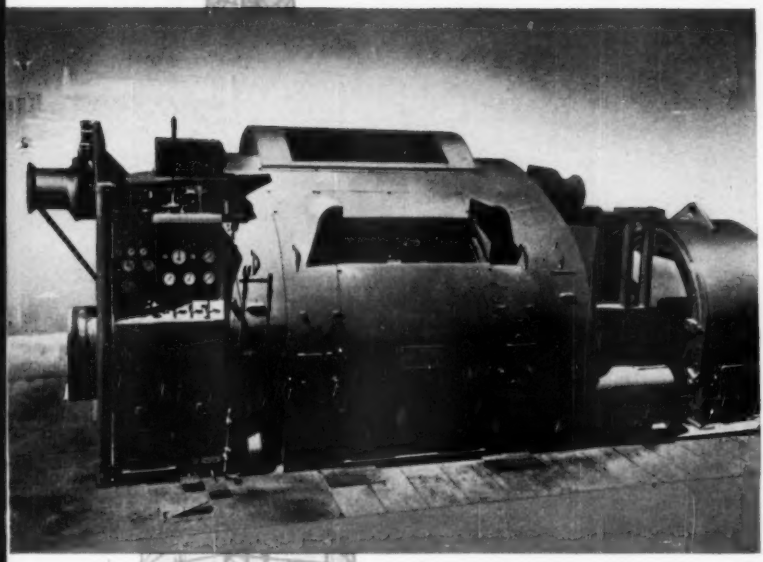
EUROPEAN LICENSEES OF M.E.C. PROCESS HYDRO-NITRO S. A., 5 QUAI DU CHEVAL BLANC, GENEVA, SWITZERLAND

CABLES: CHEMICONST, NEW YORK

CHEMICO PLANTS ARE PROFITABLE INVESTMENTS

RIG UP WITH "OILWELL"

The No. 96 Rig is your logical choice for deep well off-shore drilling because . . .



1 — All Units are Compact

Mounted on a sturdy skid-base, "Oilwell's" No. 96 Draw Works is designed to be moved with transmission in place. Its control panel has a bank of easy-to-read dials which show oil and air pressures, engine speeds and power loads; giving the driller finger-tip selection of all clutch, braking and cathead operations. All control lines between the draw works and compound drive are grouped in a single manifold.

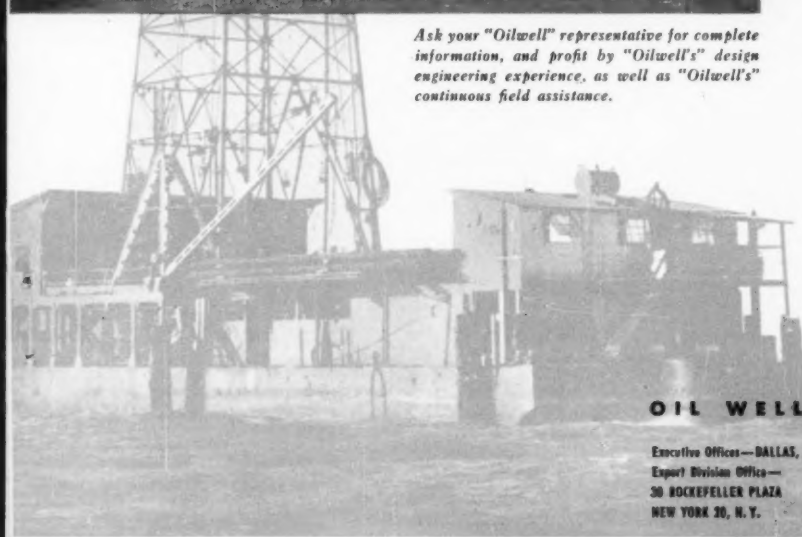
2 — Easy-to-Service

Draw Works and Drive together with the complete line of companion "Oilwell" equipment, are all designed so that wearing parts are protected, yet are readily accessible for servicing and maintenance. Unitized assemblies on major equipment items remain permanently in alignment. Facilities for adequate lubrication are provided at strategic points.

3 — Engineered to Work Together

Get maximum performance by completing your rig with (1) "Oilwell" No. 220-P Power Slush Pumps, (2) "Oilwell" No. 580 Crown Block, (3) "Oilwell" No. 480 Streamline Traveling Block, (4) "Oilwell" 400-ton Swivel (No. 300-D), (5) "Oilwell" 21-A Super-speed or 27½-B Rotaries, and (6) "Oilwell" Brantly Rotary Feed Control . . . All engineered for corresponding drilling depths.

Ask your "Oilwell" representative for complete information, and profit by "Oilwell's" design engineering experience, as well as "Oilwell's" continuous field assistance.



OIL WELL SUPPLY COMPANY

Branches Serving All Oil Fields

Executive Offices—DALLAS, TEXAS
Export Division Office—
30 ROCKEFELLER PLAZA
NEW YORK 20, N.Y.

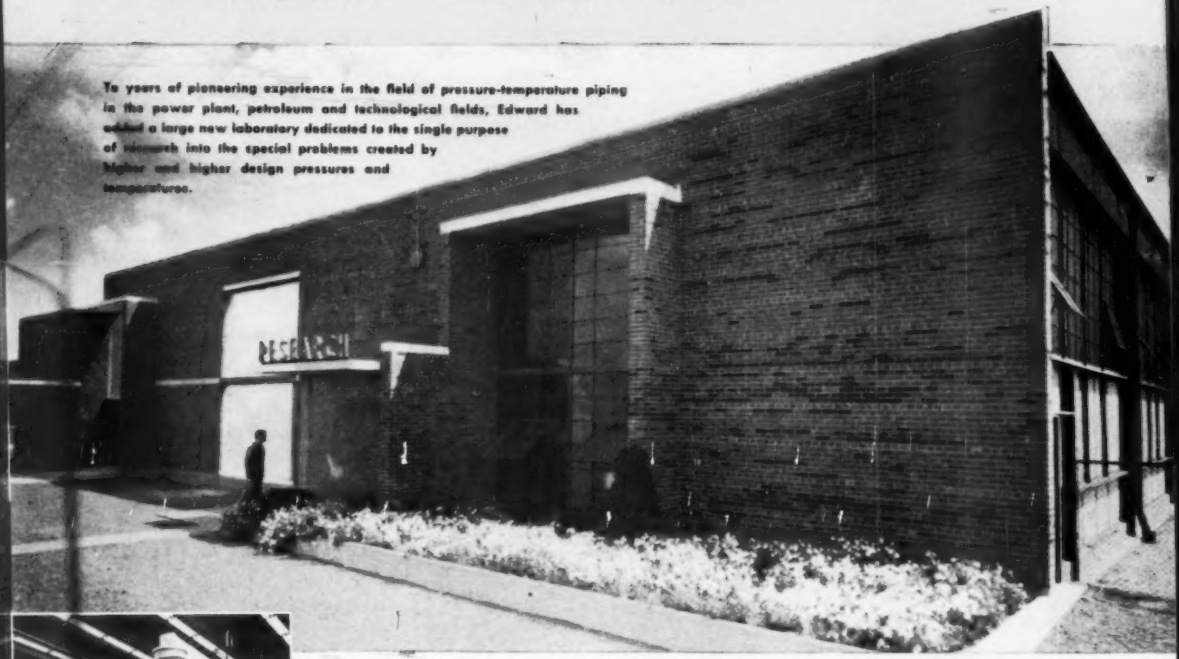
Division Offices—CASPER, WYOMING
COLUMBUS, OHIO . . . DALLAS, TEXAS
HOUSTON, TEXAS . . . TULSA, OKLAHOMA
LOS ANGELES, CALIFORNIA

USS "OILWELL"

UNITED STATES STEEL

NEW EDWARD LABORATORY PLEDGES "Finest Steel Valves"

To years of pioneering experience in the field of pressure-temperature piping in the power plant, petroleum and technological fields, Edward has added a large new laboratory dedicated to the single purpose of research into the special problems created by higher and higher design pressures and temperatures.

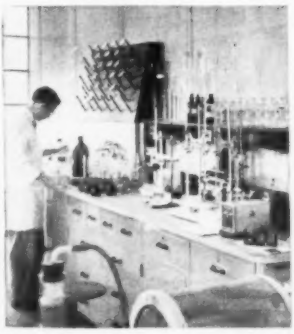


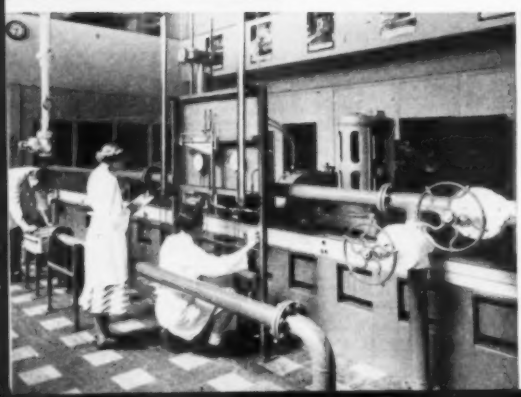
Left—Facilities developed by Edward for testing valve packings under high pressures and high temperatures.

Right—Colormetric analysis equipment in chemical laboratory for checking alloys in various steels.

Far right—Rear of creep test machine for measuring plastic flow of steel test bars under constant load at high temperatures.

Below—Flow test equipment in permanent set-up in new laboratory is used for never-ending investigation of pressure drop reduction in Edward valve designs.





No laboratory anywhere devoted exclusively to steel valve research is so well equipped and staffed. For the tough jobs . . . for steel valves from ⅛ to 14 inch . . . look to Edward. From Edward, you can *expect* the best.

Another Product

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

EAST CHICAGO, INDIANA

great names...

UNIVERSAL

CROWN AND TRAVELING BLOCKS

BETTER FOUR WAYS!

1.—Thin traveling block gives driller greater vision within derrick; also provides more space in derrick to stack pipe.

Width, OD	19⅜"

2.—Big sheaves on Universal Blocks (Crown and Traveling) give longer rope life by minimizing bend-fatigue.

Sheaves, Diameter	50"
Sheaves, Number	5

3.—The block's weight reduces side-sway—"travels like it is on a trolley."

Weight Lbs.	13,570

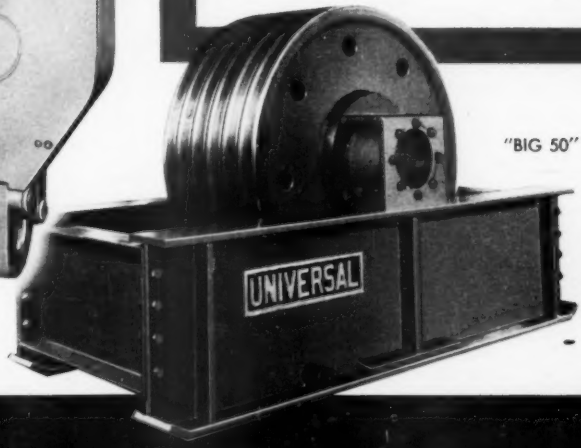
4.—Built to withstand severest oil field use over long periods of time.

Length OD	156-3/16"
Bearing Pin (Diameter)	13"
Rated Capacity, Tons	350

Universal Blocks are manufactured by L.F.M. Co., Atchison, Kansas; are available through United's 17 Stores.

Uncle Sandy

THE UNITED SUPPLY MAN



"BIG 50" SHEAVES"

Courtesy
Service
Dependability

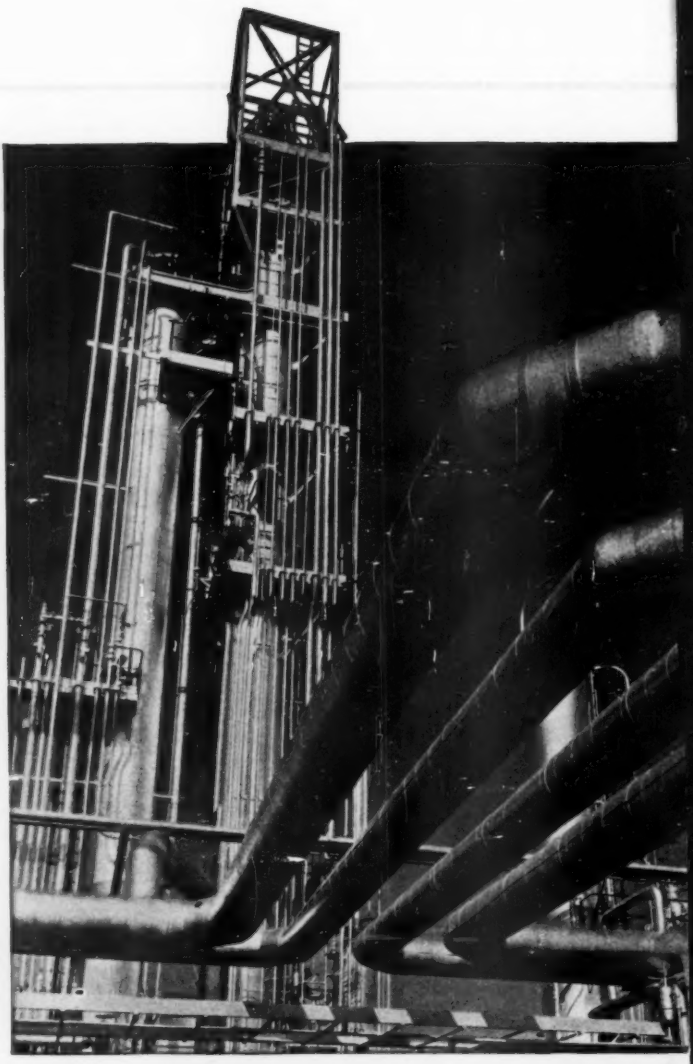
AND *Manufacturing* COMPANY

TULSA, OKLAHOMA

Stores in Kansas, Oklahoma, Texas, Louisiana, and New Mexico

YOU CAN BE **SURE**.. IF IT'S

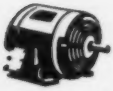
Westinghouse



Turbines

Turbo Generators

Ignitron Rectifiers



A. C. Motors

Gear Motors

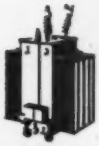
Speed Reducers

Corrosion Resisting Motor Control

Circuit Breakers for Hazardous Locations

Disconnecting Switches

Instruments



Power Transformers

Distribution Transformers and Switchgear

Capacitors

Industrial Lighting

Electronic Tubes

Oil Immersed Pushbuttons

Oil Immersed Panelboards

WESTINGHOUSE

Westinghouse

EQUIPMENT FOR THE PETROLEUM INDUSTRY

Unit Responsibility

CUTS REFINERY POWER COSTS

The manufacturer of your power generating and distribution equipment can play a vital role in providing the most efficient power system for your refining and petrochemical processes. In serving you, that manufacturer should be capable of:

1. Providing the complete line of power equipment your process may require.
2. Furnishing you co-ordinated engineering and supervision of installation.
3. Giving you the benefit of years of experience in the application of power equipment in the Petroleum Industry.

These elements of unit responsibility add up to a reduction in costs. You get them all from Westinghouse.

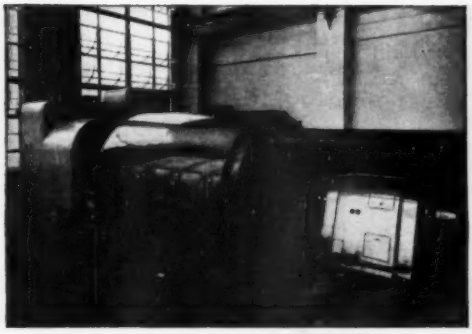
GENERATION: Westinghouse gives you the complete installation for producing power, plus help in working out your electrical and steam requirements for most efficient plant balance.

DISTRIBUTION: Westinghouse makes a correlated line of distribution apparatus, ranging from the smallest arrester to the world's largest substation. All indoor and outdoor enclosures are Bonderized to resist corrosion, and outdoor switchgear is additionally protected by all-weather undersurface coating.

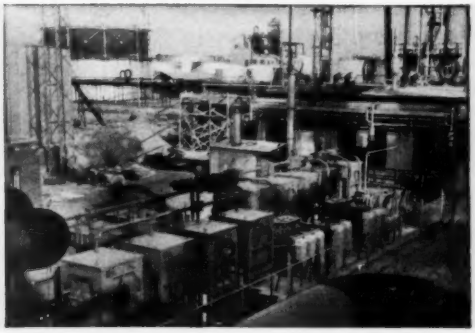
UTILIZATION: Westinghouse makes a full line of mechanical drive turbines and oil refinery motors, ranging from small, explosion-proof, fan-cooled, Life-Line motors to the largest explosion-resisting, inert-gas-filled, squirrel-cage type motors ever built. A complete line of Westinghouse controls, including corrosion-proof or explosion-proof types where needed, is also available to meet the rigid requirements of refinery service.

Give us an opportunity to assume this unit responsibility and help you find the solution to your refinery power problems. Call your nearest Westinghouse office, or write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

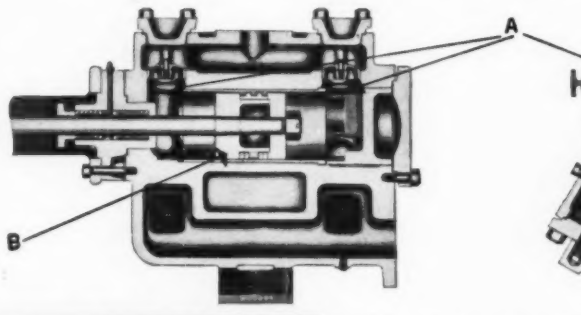
J-94803



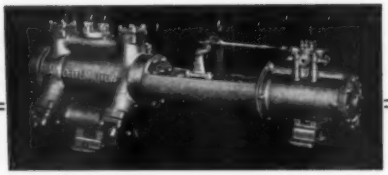
This Westinghouse 7500-kva turbogenerator is installed in a large refinery power plant. Where utility power is not available in sufficient quantities for a large refinery, units of this type provide an economical source of power.



The use of Westinghouse oil-immersed equipment suitable for hazardous and corrosive atmospheres made it possible to locate this motor control and distribution center near the loads, thus reducing length of individual circuit runs.



HiVol features for maximum volumetric efficiency in handling volatile liquids: (A) Valves placed immediately above and below cylinder bore for straight upward flow and closest clearance; (B) Extra-long liquid piston makes clearance even less.



Worthington HiVol Pumps are Horizontal Simplex Direct-Acting.

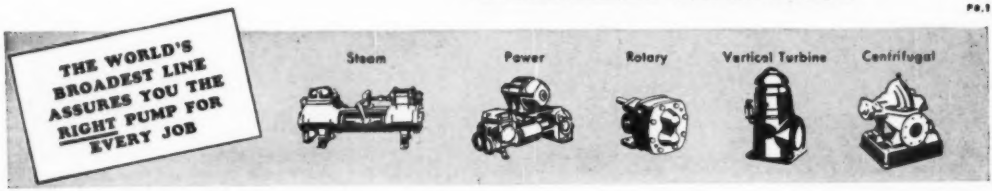
Highly volatile liquids often flash into vapor during pumping. If this vapor becomes trapped in the pump's liquid cylinder, it merely compresses and expands there, blocking the flow of liquid. But if the vapor is compressed in a small enough space, the high pressure developed will open the discharge valves and free the gas.

The closer its cylinder clearance (free space between the liquid piston, at the end of its stroke, and the suction and discharge valves) the easier it is for a pump to purge itself of entrapped gases.

In Worthington HiVol Pumps the valves are immediately adjacent to the cylinder bore, and so arranged that flow is in the straight-upward, natural path of gases. Long connecting passageways are eliminated, while extra-long pistons further aid in providing closest possible clearance.

Many Other Advanced Features combine to make Worthington HiVol Pumps unbeatable for economical, trouble-free handling of volatile and compressible liquids. Send for Bulletin W-113-B32, with HiVol details proving *there's more worth in Worthington. Worthington Pump and Machinery Corporation, Reciprocating Pump Division, Harrison N. J.*

WORTHINGTON



IN REFINERIES

OIC SETS THE PACE IN VALVES

OIC Valves make flow control a smooth, easy operation. Every husky moving part of an OIC Valve is accurately machined for clockwork precision. There's no "chatter"—friction is cut to a minimum!

There's no chance for excessive friction or pressure-reducing turbulence in an OIC Valve's streamlined, straight-through channel. The sturdy I-beam wedge raises entirely clear of the flow.

Other smooth-operating features: A rugged T-head-and-slot connection between the wedge and stem allows easy adjustment of wedge to seats, without danger of binding or galling. Packing gland and gland flange have matching spherical bearing surfaces, distributing pressure evenly to the packing, preventing uneven operation of the stem.

All these features and many more show why, for *all* flow requirements, OIC Valves are "smooth operators"!

In Sinclair Refining Company's East Chicago Refinery, engineered and constructed for Sinclair by C. F. Braun & Company, OIC Valves help control exacting processes that are responsible for one of America's best known petroleum products.

WRITE for Chart That Simplifies Your Valve Replacement Problems!

Changing valves is easy. Simply use OIC's handy Cross Reference Chart! Check the number of the valve you wish to replace, look in the OIC Cross Reference Chart, and you'll find the correct OIC Valve for the job. For your free copy, write to The Ohio Injector Company, Wadsworth, Ohio.

OIC

VALVES

STEEL • IRON • BRONZE

0-349-14

M=PT ... BASIC FORMULA FOR PETROLEUM ENGINEERS

Apply this basic formula, M=PT (Morse means Power Transmission), and you'll get:

1. An unmatched line of silent and roller chain drives, clutches and couplings. Wide range of sizes, capacities and ratings in stock.

2. The economies of mass-production with automatic machinery—*a lower cost for you.*

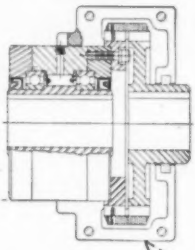
3. Power transmission products backed by a 51-year record of specialization in precision engineering and mechanical craftsmanship.

4. The application experience of Morse Power Transmission engineers—partners in the design and development of a very great variety of products.

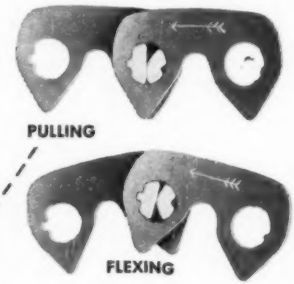
And you get the *extra margin of profit* that results from buying all your power transmission equipment from a single source—the leader in power transmission. Morse Chain Company and Morse Chain Distributors.

Keep your catalog file up-to-date! Send coupon for latest data and specifications on Morse Roller and Silent Chain Drives, Clutches, Couplings and Driveshafts.

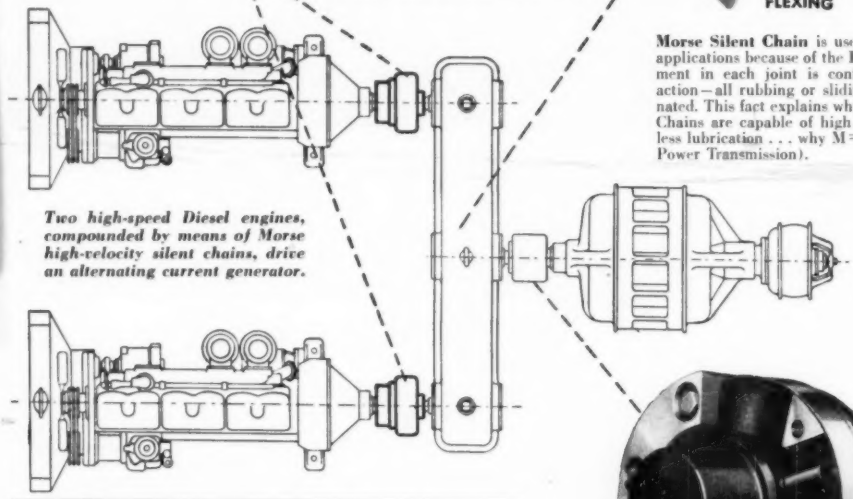
Typical Application of Morse Power Transmission Products



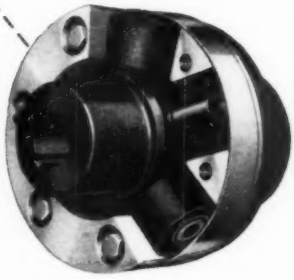
Morse-Formsprag Clutch Couplings combine full complement Morse-Formsprag over-running clutches and Morse flexible couplings. The over-running clutch automatically engages when torque is applied—disengages when torque ceases. The automatic action is instantaneous to protect equipment in the event of failure of either engine. Morse flexible couplings compensate for misalignment.



Morse Silent Chain is used on high velocity applications because of the Rocker Joint. Movement in each joint is confined to a rocking action—all rubbing or sliding motion is eliminated. This fact explains why only Morse Silent Chains are capable of high velocities—require less lubrication . . . why M=PT (Morse means Power Transmission).



Two high-speed Diesel engines, compounded by means of Morse high-velocity silent chains, drive an alternating current generator.

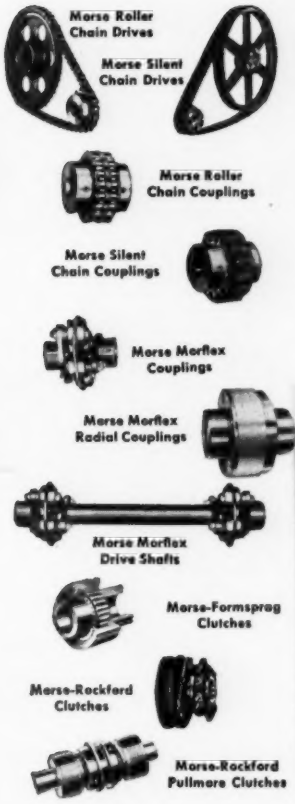


Morse Morflex Radial Couplings with resilient, preloaded rubber "biscuits" are ruggedly constructed, and torsionally flexible. Morflex Radial Couplings compensate for misalignment, absorb shock and dampen vibration. These qualities result in smooth, vibration-free power transmission. M = PT (Morse means Power Transmission).

ASK the Morse Man nearest you . . . today!

From coast to coast there are more than 100 offices, representatives and distributors of Morse Power Transmission products to give you quick information and service when you want it—where you want it. *Ask the Morse Man first in any case!* **Check your classified telephone directory under "Power Transmission" or "Chains."**

Morse *means* Power Transmission



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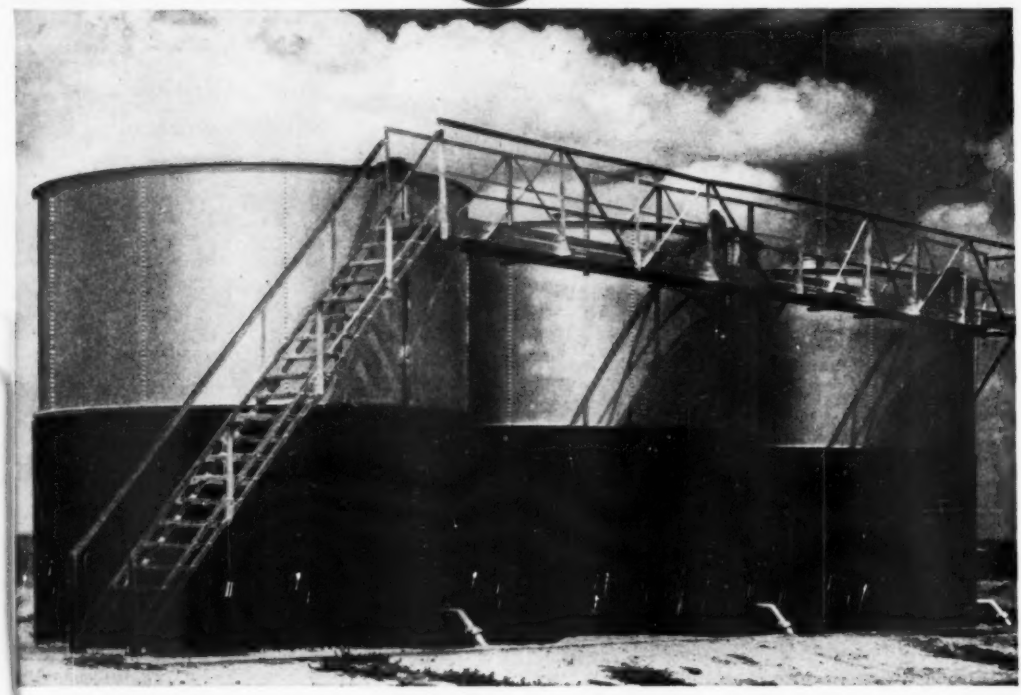
ANOTHER 3M COMPANY NEWS STORY



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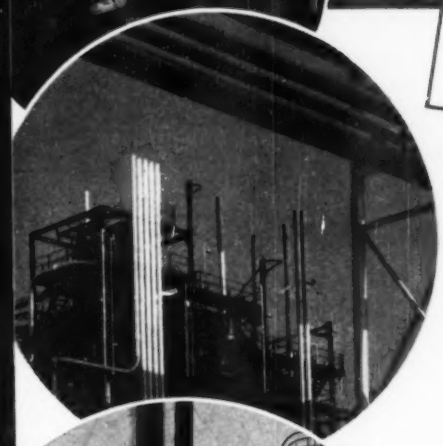

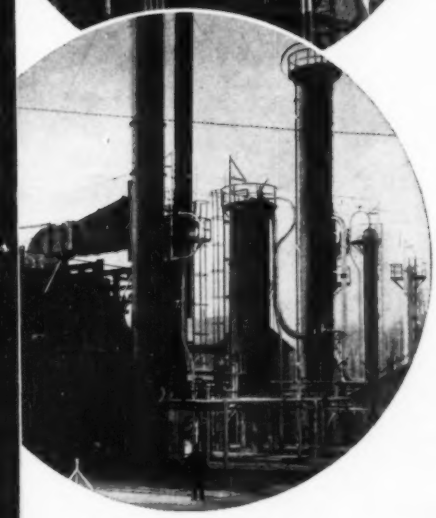

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● When the question of tubing comes up for a new installation or for replacement, don't cross your fingers and "take a shot in the dark," noping that your choice will be right. Come to Tubing Headquarters. Tell us what conditions are at your plant . . . what you expect of the pipe and tubing you buy. The chances are that we have already helped someone handle a similar situation . . . *and successfully*. In fact our files are filled with case histories, the results of laboratory tests, and actual field observations involving U·S·S NATIONAL Pipe and Tubing under practically every condition of temperature, pressure, corrosion and exposure.

Out of all this research and study have come important developments in tubing steel which enable NATIONAL to now offer you Seamless Steel Tubes, Condenser Tubes, Heat Exchanger Tubes, and Refinery Piping in *25 different analyses*. Each of these 25 different analyses has been performance-proved to meet the specific conditions of corrosion and oxidation for which it is recommended.

FOR STILL TUBES · CONDENSER TUBES HEAT EXCHANGER TUBES · REFINERY PIPING

- Low Carbon
- Low Carbon, ½ Moly.
- Low Carbon, 1 Moly.
- ½ Cr., ½ Moly
- 1¼ Cr., ½ Moly
- 2 Cr., ½ Moly
- 2 Cr., ½ Moly., 1¼ Sil.
- 2¼ Cr., 1 Moly.
- 2½ Cr., ½ Moly., ¾ Sil.
- 3-Cr., ½ Moly., 1¼ Sil.
- 3-Cr., 1 Moly.
- 5 Cr., ½ Moly.
- 5 Cr., ½ Moly., 1½ Sil.
- 5 Cr., ½ Moly., Titanium
- 5 Cr., ½ Moly., Columbium
- 7 Cr., ½ Moly.
- 8 Cr., 1 Moly.
- 9 Cr., 1 Moly.
- 12 Cr., Aluminum
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5. Reconditioning Operations
6. Gathering Systems
7. Recycling Operations

Materials and Application Procedure for

RECONDITIONING OPERATIONS

It has been established that the cost of reconditioning an uncoated or poorly coated pipe greatly exceeds the cost of a good initial installation.

However, when replacement is not necessary or feasible, other measures may be used to restore the line to operating condition.

If the pipe is not too badly pitted, spot welding can restore the original wall thickness. In other cases, a half-sole is recommended. Cleaning, re-priming, re-coating and re-wrapping can be counted on to extend the usefulness of the line.

Barrett can furnish coating materials for every kind of reconditioning job. If you have any trouble spots in your pipelines, call on us for help. Our long experience is at your service.

Barrett can furnish coating materials for every kind of reconditioning job.

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New WHELAND TABLE TOP ROTARY

WITH RAISED GUARD FOR SAFETY. Model A-20—20½" Through Table

FACTORY "RUN-IN"

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QUIET

PRECISION BUILT

EASY TO MAINTAIN

HIGH SPEED, TRIPLE OIL BATH ROTARY

CUTS RIGGING UP TIME

BASE: Fabricated steel plate with cast steel center. Derrick floor easily fitted to box shape. Pipe can be stacked on top surface. Safe! Steel guard raised 1¾" above revolving table.

TABLE: Steel casting rotates on precision ball bearings in hardened and ground races that take both radial and thrust loads.

BRONZE TABLE BUSHING: Alemite lubricated. Prevents scoring of table.

GEAR AND PINION: Gleason spiral gear and pinion, standard equipment. Gears are shock resistant and perfectly lubricated to run smoothly, quietly.

PINION SHAFT ASSEMBLY: Removable as a unit for easy maintenance. Shaft is forged steel, precision machined, mounted on Timken bearings. Pinion locked at factory in perfect alignment with main gear for long trouble-free operation.

INBOARD AND OUTBOARD PINION SHAFT SEALS: In addition to new, improved mechanical seal, a positive type rubbing seal excludes all grit, sand, etc., from outboard bearing.

SUPERIOR LUBRICATION: Proper grade lubricant for each part assured by three separate, securely sealed oil compartments. Fill and check from top. Three separate oil pipes with bell reducers make it easy to add oil, separate automobile type dip sticks for checking oil level.

LOCKING DEVICE: Locking device is simple, positive. Engages ring gear, eliminates shock from pinion, shaft and bearing. Lock handle on top of table, convenient to driller.

SPLIT MASTER BUSHING: Cast steel. Takes A.P.I. Standard drive bushings. Master bushing alone or both master and drive bushings can be locked to table.

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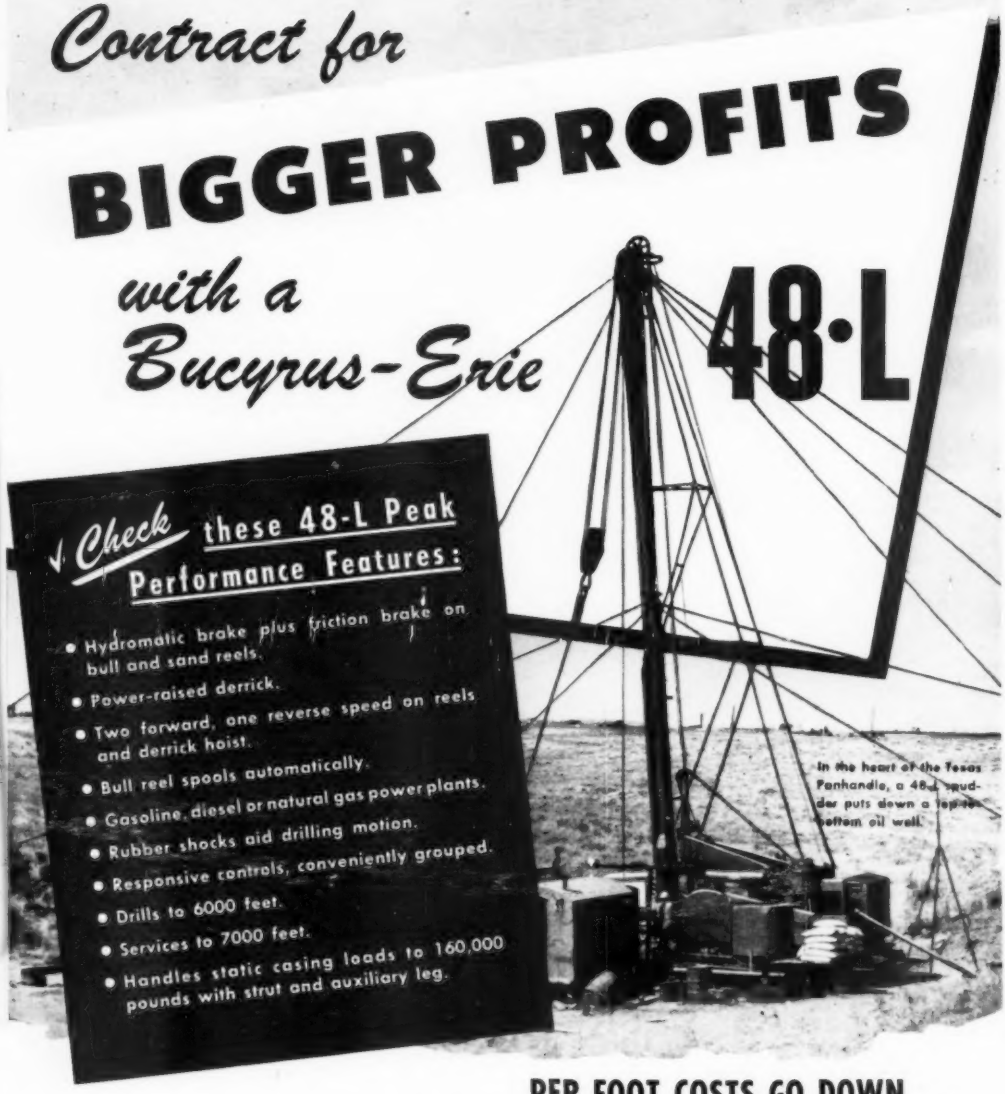

✓ Check these 48-L Peak Performance Features:

- Hydromatic brake plus friction brake on bull and sand reels.
- Power-raised derrick.
- Two forward, one reverse speed on reels and derrick hoist.
- Bull reel spools automatically.
- Gasoline, diesel or natural gas power plants.
- Rubber shocks aid drilling motion.
- Responsive controls, conveniently grouped.
- Drills to 6000 feet.
- Services to 7000 feet.
- Handles static casing loads to 160,000 pounds with strut and auxiliary leg.

In the heart of the Texas Panhandle, a 48-L spudder puts down a top-to-bottom oil well.

LOWER RIGGING AND MOVING COSTS

Trailer or skid mountings give all Bucyrus-Erie spudders cost-saving mobility. Typical is the report of a 48-L owner in Oklahoma who says his 4-man crew can tear down, move to a new location, and be ready to sink a new hole in from four to six hours.

PER FOOT COSTS GO DOWN . . .

. . . with the speedy penetrating action, economical power plants, long-wearing tools, and the large rope-saving sheaves of all Bucyrus-Erie spudders. Investigate the 24-L, 28-L, 36-L and 48-L rigs before you tackle your next job.

Contract for bigger profits by signing up with a new Bucyrus-Erie.

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Speed Increaser "Picture" Has Run Continuously For 17 Years

This is not an unusual service record for Farrel speed increasers in pipe line pumping service. In fact, *ALL* of the units installed in 1932 are still in operation, performing as well as on the day they went to work.

Farrel type SI units were the first speed increasers to be developed in a standard series, and the advantages of their design and construction have been proven by their satisfactory performance in hundreds of installations.

The Farrel SI line, today, consists of 49 standard sizes with speed ratios ranging from 1:1 to 12:1. For higher ratios, units using two sets of gears are supplied with ratio range from 12:1 to 40:1.

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Sales Offices: Ansonia, Buffalo, New York, Boston, Pittsburgh, Akron, Detroit, Chicago, Los Angeles

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FB-504

Send for bulletin which gives complete details of Farrel SI Units, including specifications, dimensions, horsepower rating tables and maximum permissible speeds. Just fill out the coupon and drop it in the mail.

Farrel-Birmingham

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344 VULCAN ST., BUFFALO 7, N. Y.

Please send me, without cost or obligation, a copy of your bulletin on speed increasers, No. 448.

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Here is Plain PROOF...

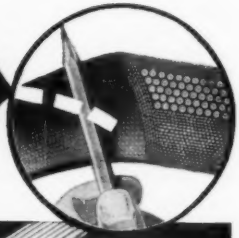
You can actually *feel* the sides of a belt *change shape* as the belt bends.

That the

CONCAVE SIDE

(U. S. Patent No. 1813698)

SAVES Transmission DOLLARS



When a *straight-sided* V-Belt bends around a pulley, three things are bound to happen.

(1) The top of the belt, being under tension, *narrows*. (2) The body of the belt, under compression, *widens*. (3) The sides of the belt *bulge out*.

These *shape changes* are inevitable. They are shown in figures 1 and 1-A, below.

Straight-Sided V-Belt.

How Straight-Sided V-Belt Bulges in Sheave-Groove.

Because this bulging belt does not fit the sheave groove, two facts become clear. (1) The belt will get excessive wear where it bulges—*shorter life!* (2) The whole side of the belt cannot *uniformly* grip the pulley—*a loss in drive efficiency.*

How different the V-Belt with the precisely engineered *concave* side (U.S. Patent No. 1813698)—the Gates Vulco Rope. As this belt bends it assumes a shape that *exactly* fits the sheave groove. (Figures 2 and 2-A, below.)

Gates Vulco Rope with Concave Side.

No Side Bulge. Precise Fit in Sheave-Groove.

Two savings result. (1) The Gates Vulco Rope wears evenly—*longer life!* It's entire side-wall grips the pulley—no slip—*full delivery of power!*

The Mark of SPECIALIZED Research

The Concave Side is MORE IMPORTANT NOW Than Ever Before

Because the sides of a V-Belt are what actually drive the pulley it is clear that any increased load on the belt means a heavier load that must be transmitted to the pulley directly through the belt's sidewalls.

Now that Gates *SPECIALIZED* Research has made available to you SUPER Vulco Ropes—carrying fully 40% higher horsepower ratings—the life-prolonging Concave Side is naturally more important in conserving belt life today than ever before.

498

GATES VULCO ROPE DRIVES

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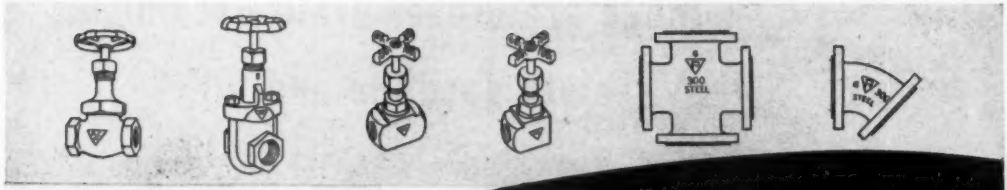
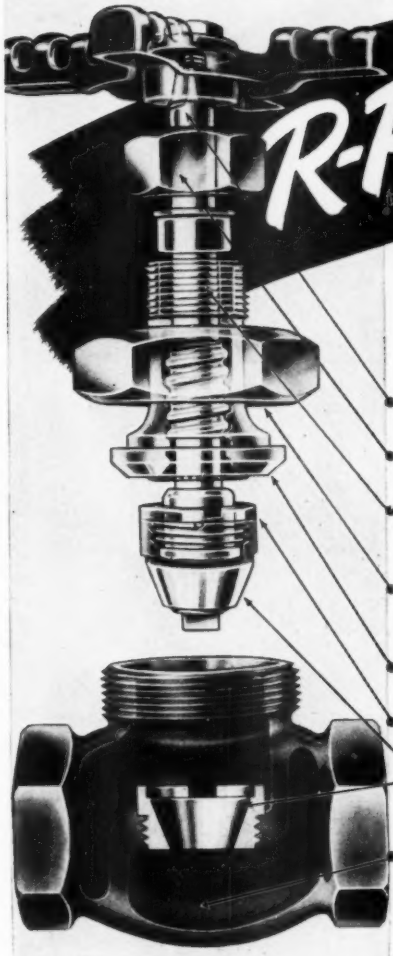
"The World's Largest Makers of V-Belts"



R-P&C HEAVY-DUTY BRONZE GLOBE VALVE



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- **STEM** high tensile rolled bronze. Large diameter and long thread contact.
- **PACKING NUT** and gland follower of heavy bronze transmit even pressure onto packing.
- **STUFFING BOX** large and deep. Packed with formed rings of braided asbestos, lubricated and graphited. Can be repacked under pressure.
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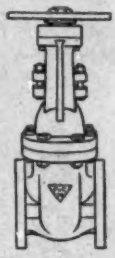
- **DISC LOCK-NUT** holds disc securely to end of stem.
- **FULL-PLUG DISC and SEAT RING** stainless steel of 500 Brinell—near diamond—hardness.
- **BODY** P & C High Test Bronze. Reinforcing ribs give added strength. Heavy end hexes with standard, full length threads.

Fig. 531-P
350 lbs. Steam • 1000 lbs. OWG



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This highest quality packing is available in sizes from ¼" to 2", packaged to suit your needs. It is just one of many R/M packings made for the oil industry. Ask your oil-field supply house, or write us, for a copy of the condensed R/M packing catalog.

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KAYDON Radial Ball Bearings 15.000" x 19.000" x 2.000" in Food Machinery Corporation's New Juicer

KAYDON BEARINGS

help SUPER JUICER squeeze 480 OPM*

*Oranges per minute

KAYDON Bearings play a very important part, say the designers, in this remarkable machine, so aptly christened the FMC SUPER JUICER. KAYDON precision radial bearings support the entire revolving head, including the actuating cam and upper cups of the squeezing mechanism, the head traveling smoothly, 24 revolutions per minute.

SUPER JUICER is *right!* Produces upwards of 300 gallons of juice per hour. It's super *juice*, too . . . tastes fresher, keeps better . . . since the juicing operation keeps the juice from the inside of the citrus fruits from mixing with the oil from the rind.

FMC engineers recognize the advantages of KAYDON precision bearings, just as designers of many other types of heavy-duty machinery do, in such widely varied fields as oil field machinery, rock-crushers, grinders, steel mills and paper mills, road equipment, excavators, hoists, bending machines and otlfer heavy-duty equipment.

For sound bearing-cooperation, contact KAYDON.

KAYDON *Types of Standard or Special Bearings:*
Spherical Roller • Taper Roller
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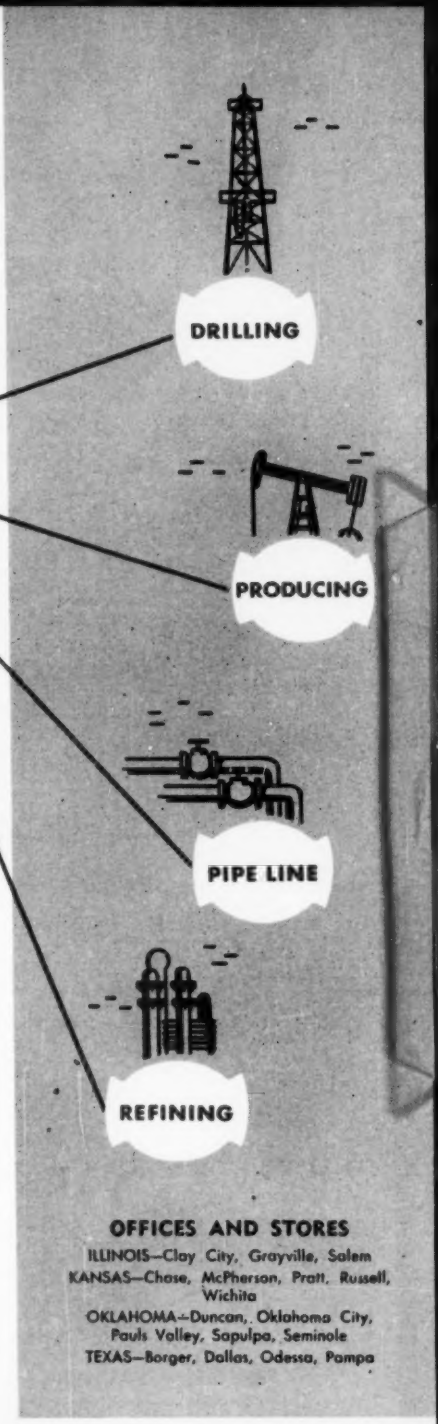

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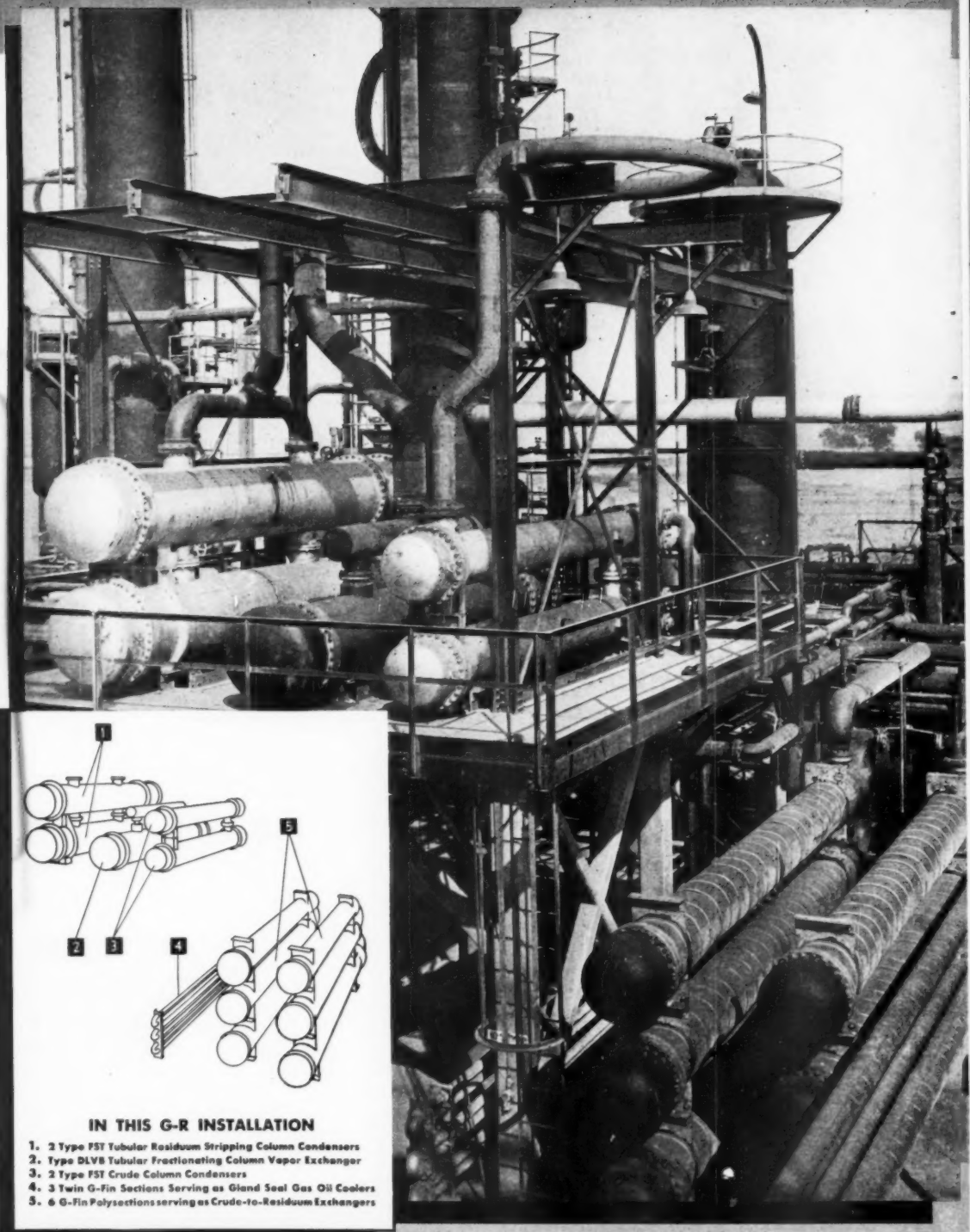

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GRISCOM-RUSSELL: PIONEERS IN HEAT TRANSFER APPARATUS

Meet this G-R family group of HEAT TRANSFER APPARATUS

In the illustration on the adjoining page, you will find some of the large family of G-R heat transfer apparatus. This particular group includes finned tube and bare tube units . . . condensers, heat exchangers, and coolers.

Many additional G-R units, not shown in the illustration, and including condensers, heaters, coolers, subcoolers, reboilers, and heat exchangers on a great variety of services were also furnished for this representative plant.

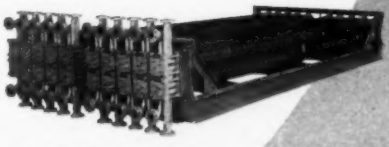
Throughout the petroleum industry in the United States and abroad, in refineries, natural gas and gasoline plants, and in pipe line pumping stations, G-R heat transfer apparatus has made records of effectiveness, economy, and durability on standard and special services. To assure best results in your heat transfer operations, standardize on G-R apparatus.

THE GRISCOM-RUSSELL CO.
285 Madison Avenue, New York 17, N. Y.

SOME STANDARD DESIGNS OF G-R HEAT EXCHANGERS

G-R Twin G-Fin Section — with finned type heat transfer elements that compensate for the unequal heat transfer rates of fluids of high and low heat conductivity.

G-R Tubular Exchanger — with several distinctive features that provide most effective heat transfer and minimum maintenance expense.



G-R Tubeflo Section — the only design of heat transfer apparatus that maintains rated capacity with clogging or dirty fluids.

GRISCOM-RUSSELL

Dependable Power with KOPPERS K-SPUN Piston Rings

THE tough grind of scheduled service on the Alcan Highway is another recent experience that demonstrates the superiority of Koppers Piston Rings. They have set new records for dependability and economy in airliners, Diesel locomotives, ocean-going tugs—every kind of service on land, sea, and in the air.

The reasons for the spectacular performance of Koppers American Hammered Piston Rings are these—K-Spun, the miracle metal for piston rings, and Porous Chrome* plating. Where dependability and economy are "musts," you'll find that engine builders and operators specify Koppers Piston Rings.

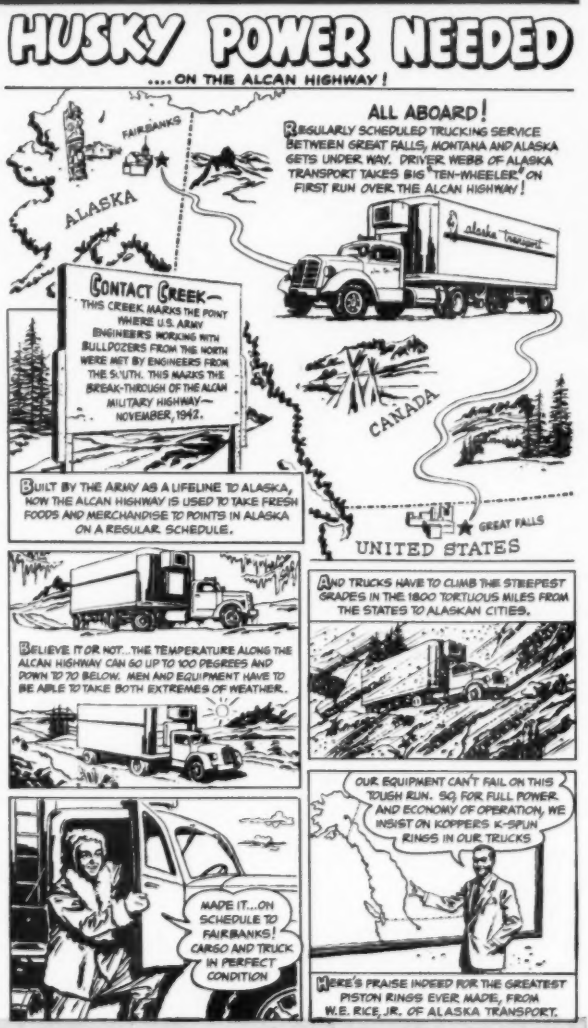
Take the first step to longer ring life and better performance—check with Koppers engineers. Koppers Company, Inc., Piston Ring Dept., Box 626, Baltimore 3, Maryland.

*VAN DER HORST PROCESS

★

WHAT POROUS CHROME PLATING AND K-SPUN METAL MEAN TO YOU

1. Guaranteed against ring breakage. Tensile strength double ordinary gray iron castings.
2. All rings seat immediately without scuffing and scoring.
3. Ring and cylinder wear greatly reduced.
4. Fifty percent more elasticity—retains shape and tension far longer.
5. Four times greater impact strength means long life in severe service.


HUSKY POWER NEEDED
....ON THE ALCAN HIGHWAY!
ALL ABOARD!
REGULARLY SCHEDULED TRUCKING SERVICE BETWEEN GREAT FALLS, MONTANA AND ALASKA GETS UNDER WAY. DRIVER WEBB OF ALASKA TRANSPORT TAKES BIG "TEN-WHEELER" ON FIRST RUN OVER THE ALCAN HIGHWAY!
FAIRBANKS
ALASKA
CONTACT CREEK—
THIS CREEK MARKS THE POINT WHERE U.S. ARMY ENGINEERS WORKING WITH BULLDOZERS FROM THE NORTH WERE MET BY ENGINEERS FROM THE SOUTH. THIS MARKS THE BREAK-THROUGH OF THE ALCAN MILITARY HIGHWAY—NOVEMBER, 1942.
CANADA
BUILT BY THE ARMY AS A LIFELINE TO ALASKA, NOW THE ALCAN HIGHWAY IS USED TO TAKE FRESH FOODS AND MERCHANDISE TO POINTS IN ALASKA ON A REGULAR SCHEDULE.
RUN
GREAT FALLS
UNITED STATES
BELIEVE IT OR NOT...THE TEMPERATURE ALONG THE ALCAN HIGHWAY CAN GO UP TO 100 DEGREES AND DOWN TO 70 BELOW. MEN AND EQUIPMENT HAVE TO BE ABLE TO TAKE BOTH EXTREMES OF WEATHER.
AND TRUCKS HAVE TO CLIMB THE STEEPEST GRADES IN THE 1800 TORTUOUS MILES FROM THE STATES TO ALASKAN CITIES.
MADE IT...ON SCHEDULE TO FAIRBANKS! CARGO AND TRUCK IN PERFECT CONDITION
OUR EQUIPMENT CAN'T FAIL ON THIS TOUGH RUN. SO, FOR FULL POWER AND ECONOMY OF OPERATION, WE INSIST ON KOPPERS K-SPUN RINGS IN OUR TRUCKS.
HERE'S PRAISE INDEED FOR THE GREATEST PISTON RINGS EVER MADE, FROM W.E. RICE, JR. OF ALASKA TRANSPORT.

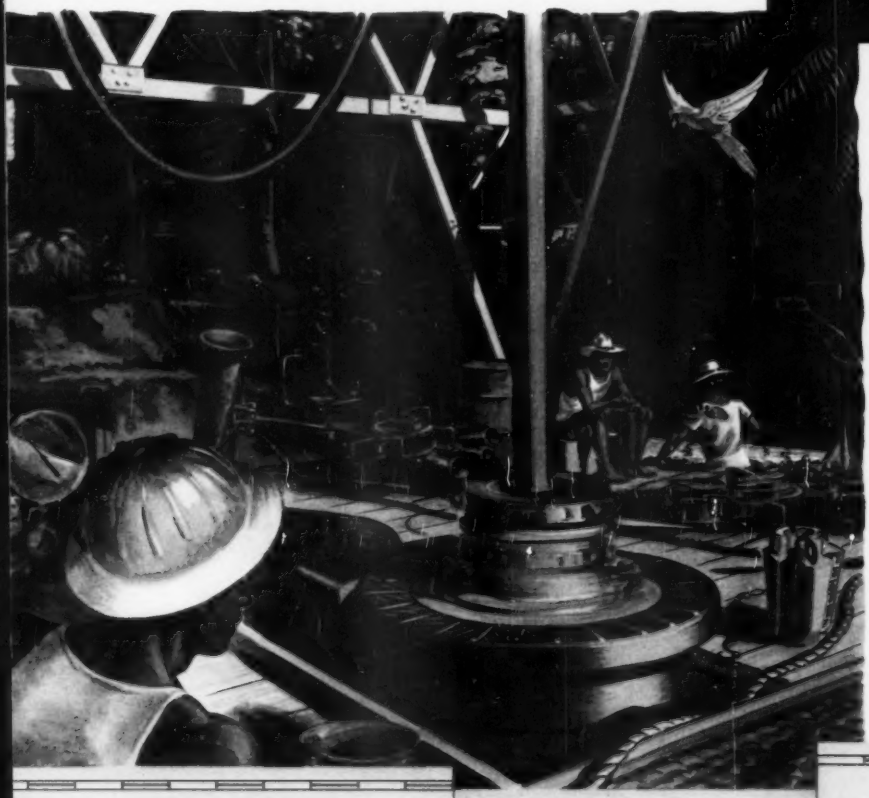
KOPPERS

American Hammered

KOPPERS PISTON RINGS

—Field Proven the World Over···

EMSCO RUGGED ROTARIES



Wherever drilling equipment is found . . . whenever efficiency and dependability are a must . . . you will find Emsco Rotary Machines. This world-wide acceptance is the result of more than a quarter century of specialized experience in the manufacture of rotary machines. Today, Emsco rotaries represent the most advanced engineering design for this type of equipment. The fabriform base provides greater strength, more rigidity and less weight. Ring gears and pinions are precision machined from alloy steel forgings. This assures quiet and efficient operation at all times. All gear teeth are flame hardened assuring maximum service life. These and many other design and construction features make Emsco rotaries the finest in the market. Ask your nearest Continental-Emsco representative for complete information.

"J" Series—A group of heavy duty Rotary Machines with 20¾-inch opening designed for trouble-free deep drilling. Rated tonnage capacity under dead load: 250, under rotating load: 125 tons.

KS-27½—A heavy duty Rotary Machine engineered for efficient and economical drilling of big hole and for the toughest service. Rated tonnage capacity under dead load: 300, under rotating load: 125 tons. Table opening: 27½ inches.

MS-15—A sturdy, lightweight Rotary Machine for shallow and medium-depth drilling. Rated tonnage capacity under dead load: 125, under rotating load: 50 tons. Table opening: 15 inches.

ADV 1367-49

CONTINENTAL

THE CONTINENTAL SUPPLY COMPANY

General Offices: DALLAS, TEXAS • The Continental Supply Co., Limited, 214 Lancaster Bldg., Calgary, Alberta • Export Division, The Continental Supply Company, Inc., 30 Rockefeller Plaza, New York, N. Y. • Representatives: Argentina, Bolivia • Brazil • Chile • China • Colombia • England • Sweden • Peru • Trinidad • Uruguay • Venezuela

Round the clock Performance

Tour after tour, day after day, year after year . . . that's the kind of continuous 'round-the-clock performance rendered by all Emsco products. Take the Emsco GA-350 Drilling Rig for example. Here's a 350-horsepower rig engineered for day-in, day-out trouble-free performance. An automatic oil bath system eliminates costly, time-consuming shut-downs for oiling and greasing. Air-operated controls speed-up drilling operations, lower drilling costs. Picture a GA-350 with an Emsco Portable Mast, NS-15 Rotary, AE-4 Swivel and ND-36 Traveling Block on any oil field panorama, and you have the key to faster, easier and more economical drilling of medium depth holes.

EMSCO DERRICK & EQUIPMENT COMPANY

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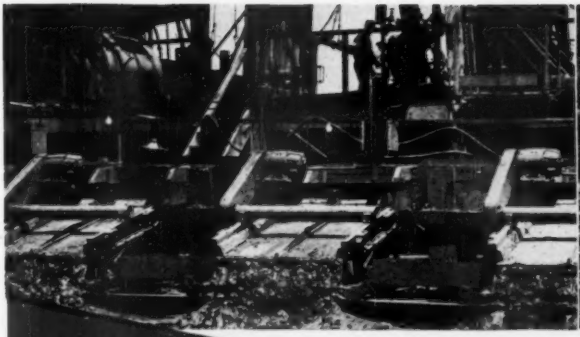
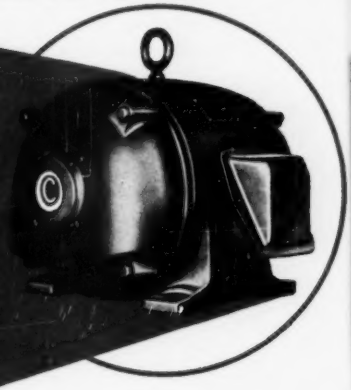


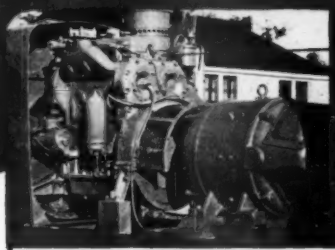
Three Century 2 horsepower direct current motors driving mud screens.

Century 5 horsepower Type SCT splash-proof three phase squirrel cage motor operating an oil well pump jack.

Century Oil Field MOTORS



Assure Continuous, Economical Operation



Century 30 KW direct current generator mounted with a gas engine drive for oil field power.

Century splashproof oil field motors are scientifically designed to resist the hazards of outdoor installation. They keep falling solids, as well as dripping and splashing liquids, out of the vital parts of the motor — assure dependable operation in all kinds of weather.

Century Type SCT three phase squirrel cage pumping unit motors save wear and tear on equipment. Their "high slip" permits the motor to slow down as the load comes on — thus cushioning the impact of the peak load and reducing the sudden shock to both motor and equipment.

Specify Century motors for all your electric power requirements. You can get complete information at your regular supply store.

Popular sizes and standard ratings are generally available from factory and branch office stocks.

Century GENERATORS

Where public service current is not available, Century Generators will provide adequate, continuous electric power. Depending on the load per motor and the size of generator, from 10 to 30 wells can be operated from one generator. They provide a dependable source of oilfield power.

Century C MOTORS

-611

CENTURY ELECTRIC COMPANY
1806 Pine Street, Saint Louis 3, Missouri

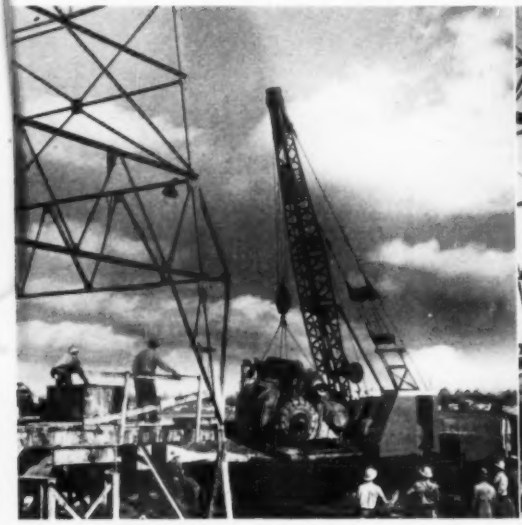
BAY CITY CRANEMOBILE

goes anywhere—anytime to do tough jobs in a hurry

Regardless of terrain or operating conditions the BAY CITY 180 CraneMobile handles any oil field job quickly and efficiently . . . like this CraneMobile, working for Hupp Crane Service of Long Beach, California, gently easing bulky draw works into position on the rig floor.

With powerful six-wheel drive and 12 forward speeds ranging from "creeper" to 30 M.P.H. road speed, the CraneMobile goes anywhere, anytime.

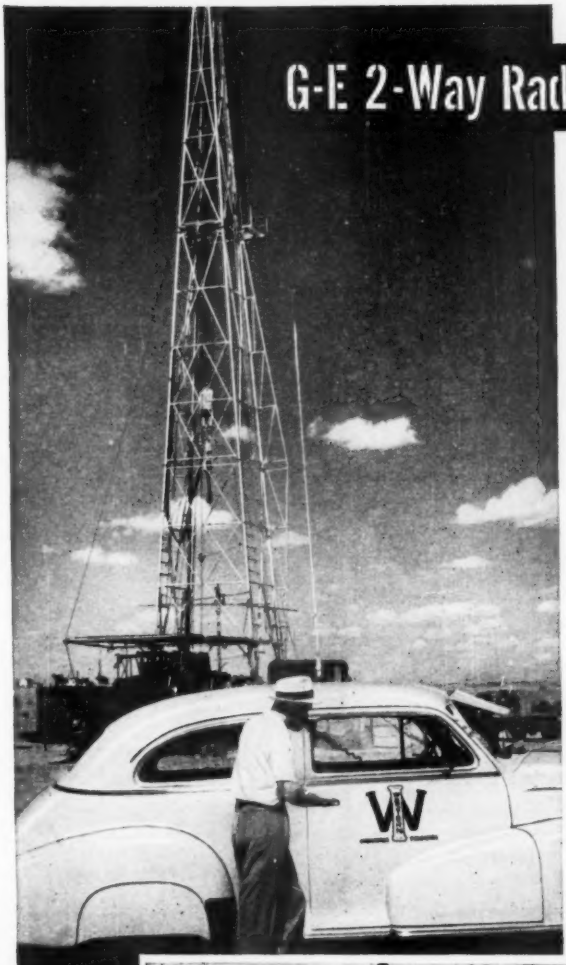
Operators like BAY CITY'S quick responsive swing and booster type clutches that mean smooth, positive operation at all times. Sound engineering plus rugged construction means steady day-in, day-out high performance without costly "down-time" for repairs. From every angle CraneMobile is a better buy. Write, wire or phone for facts today.



BAY CITY

SHOVELS • CRANES • HOES • DRAGLINES • CLAMSHELLS

BAY CITY SHOVELS INC., BAY CITY, MICHIGAN See your nearest Bay City dealer for excavating and material handling equipment in sizes from ⅜ to 1¼ yard with crane rating up to 20 tons. Both crawler and pneumatic tire mountings.



Speeds up acidizing better timing— better service

HERE'S how the Western Company of Midland, Texas provides fast, efficient perforating and acidizing service to drillers in West Texas and New Mexico. Custom-built trucks, with General Electric 2-way radio, carry guns, acid and instruments ready for instant action at well sites. With this equipment crews and field offices are in constant voice communication.

Operators like the way Western engineers reduce "down time" at the well. Western officials like the way G-E radio permits *instant communication* over wide areas—an extra plus that brings in jobs where time is an important consideration.

Reagan County—Largest one-stage acidizing treatment in the Permian Basin. Western trucks shown here are equipped with G-E radio, putting crews in instant touch with company field offices and supply points.

General Electric makes a specialty of radio communication for the oil industry. Call or wire the G-E office nearest you. This booklet FREE on request. *General Electric Company, Room 239, Bldg. 1, Electronics Park, Syracuse, New York.*

You can put your confidence in—

GENERAL ELECTRIC

"SCOREKEEPER FOR MODERN OIL FIELDS"

BOWSER PORTACHEK

- ACCURATELY RECORDS GROSS PRODUCTION
- FURNISHES TRUE PROPORTIONAL SAMPLE
- PROVIDES PERMANENT, INDISPUTABLE RECORDS
- DETECTS SLEEPERS OR WET WELLS

and by **ELIMINATING GAGE TANKS,** *Portachek—*

- REDUCES PUMPING AND TRANSPORTATION COSTS
- STOPS EVAPORATION LOSSES
- MINIMIZES FIRE HAZARDS

ENGINEERED TO HANDLE ANY TYPE OF OIL WELL PRODUCTION WITH THESE *PROVED* WELL-CHECK UNITS

1. Bowser Special Oil Well Xacto Meter.
2. Bowser True Proportional Sampler.
3. Bowser Spillproof Gas Trap with patented Peel-Off Valve—no packing glands—no valves to grind or adjust.

Dependable operation is assured on flowing wells, pump pressure or vacuum—either as mobile units or for permanent installations. Bowser meter engineers are always at your service for counsel or recommendations on Well-Check Systems for all types of wells. Write Bowser, Inc., 1328 Creighton Avenue, Fort Wayne 2, Indiana, or direct to the nearest district office.

SALES AND SERVICE • • • •

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Room 650A, M & M Bldg.,
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BOWSER OIL WELL METER WITH AUTOMATIC SAMPLER

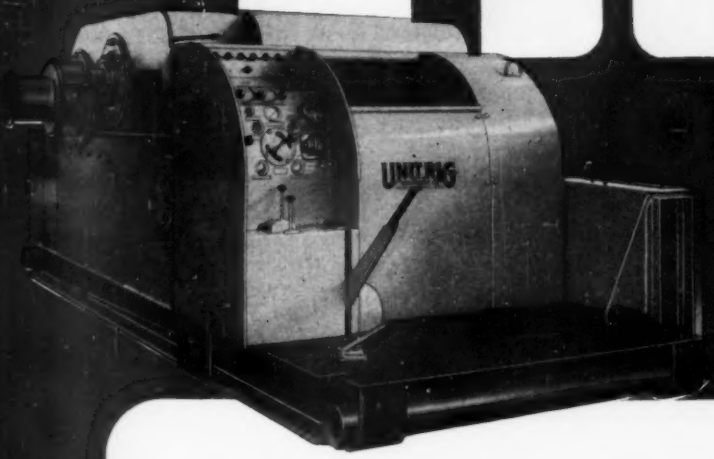
. . . provides reliable records of oil well production—*both quantity and quality*—AT THE WELL!

PEEL-OFF VALVE

This simple valve eliminates conventional back pressure regulator, oil valve and float flange. *There's nothing to get out of order!*

BOWSER ESTABLISHED 1885

U-30



DOWN UNDER 12,500 FEET AND STILL TAKING IT EASY

When the first U-30 drilled to over 12,000 feet, the operator reported that the rig was still "taking it easy". Further drilling has proved that the basic design on the U-30 is RIGHT.

Now the U-30 is in quantity production. It's ruggedness, speed and ease of operation have proved beyond a doubt that it can drill the world's deepest wells with the minimum of effort.

UNITRIG & EQUIPMENT CO.
TULSA, OKLAHOMA U.S.A.

DESIGNED FOR THE JOB....

Exclusive Export Representative
MID-CONTINENT SUPPLY CO.
42 Broadway, New York City
Cable Address: MIDUNITRIG

Bandwagon rolling for OIL PROGRESS WEEK!

During the week of October 16th-22nd, your community's attention will be focused on the oil industry! For that's the date of Oil Progress Week—the week that gives you a chance to report the progress you and your industry have made.

Last year, Oil Progress *Day* gave thousands of oil men across the country a great chance to tell their story—and they did, with results that paid off handsomely in good will and good business. This year, with an entire *week* devoted to the event, you've got an even greater opportunity to explain how your firm is helping to provide America with *better*, more efficient oil products ... higher standards of service.

You're the One Who Gains!

YOU gain when your customers understand the competition in oil—the way you compete with rival companies to win customer approval. For as the public learns what a great job you're doing, they'll understand why your business freedom means *more* oil products, *better* oil products, better service for *them!*

Hurry! Get Ready For Your Big Week!

Get free material to promote Oil Progress Week from your local committee office. You can adapt it to fit your needs. Tie in ads ... sample speeches ... booklets ... motion pictures ... employee meeting material ... poster designs ... radio material ... everything you need to make Oil Progress Week *your* week!

Here's how you can benefit from Oil Progress Week

During Oil Progress Week get people acquainted with your business. That way, your neighbors will get a new understanding of the problems you face ... an understanding that's *bound* to result in more friends for YOU! Tell them about today's new and better oil products ... how *hard* you've worked to maintain and step up your high standards of quality and service—and you create good will that pays off for *you* and *your firm* in the long run!

Get in touch with your district committee NOW!

They'll make it easy for you to make the most of Oil Progress Week. They'll give you material you can use to tie your business in with this big nation-wide report!

Get in touch with your local O.I.I.C. office NOW, or write to national office address listed below.

OIL INDUSTRY INFORMATION COMMITTEE
50 West 50th Street • New York 20, N. Y.

Don't miss this chance to stand out in your community! Make Oil Progress Week Your Week!

FOR INDUSTRIAL USES

Better WATER SERVICE...

Better FIRE PROTECTION...

Better LONG-TERM ECONOMY...

with

PITTSBURGH ·DES MOINES

Elevated Steel Tanks

Completely dependable water service for general plant use—including storage of cooled water and other process applications—combines with ever-present fire protection to create immediate value in your Pittsburgh-Des Moines Elevated Steel Tank. Year-after-year durability and low maintenance costs are P-DM values that steadily enhance your investment. *May we give you the details?*

PITTSBURGH · DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

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NEW YORK	Room 980, 270 Broadway	DALLAS	1201 Praetorian Building
CHICAGO	1202 First National Bank Bldg.	SEATTLE	906 Lane Street
	SANTA CLARA, CAL.	603 Alviso Road	

JOB RECORDS SHOW

Top Performance with TOLEDO SIMPACT

AUTOMATIC DRIP OILING. Oil pockets in head of a Toledo Simpact collect oil and drip directly on dies.

Finest of all SELF-CONTAINED 1" to 2" THREADING TOOLS

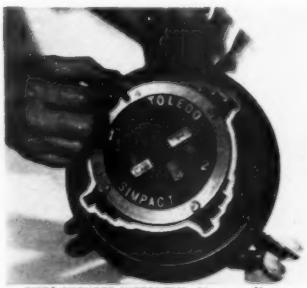
You can do the job in a jiffy with a Toledo Simpact—a great tool for all-around use!

It's self-contained . . . one set of high speed steel dies for four pipe sizes, 1" to 2" pipe . . . sizes changed in a matter of seconds . . . extremely easy to operate . . . produces accurate leak-proof threads. Has few moving parts . . . light in weight . . . strong and sturdy. Dies can be reground when dull. 3-jaw pipe holder is designed for easy handling and accurate centering. Handle 24" long. Amazingly compact—the Simpact will thread a pipe projecting through a wall as short as 6¼". Weight complete only 20¼ lb. See it—try it—compare. Ask your Toledo supply distributor, or write for catalog. The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office: 165 Broadway, Room 1310.

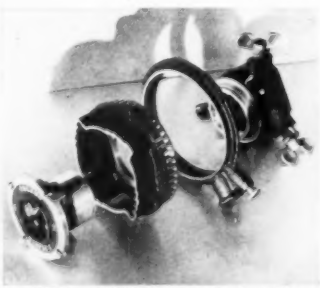
RELY ON THE LEADER

TOLEDO

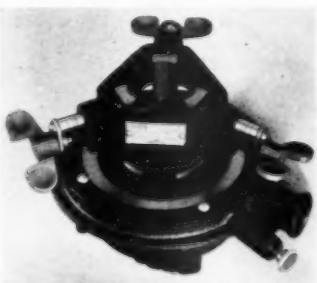
FOR PRECISION PIPE TOOLS



SIZES CHANGED INSTANTLY. Simpact dies are changed from one size to another easily and quickly. Positive, practical die setting.



SIMPLE . . . COMPACT. Note the simplicity of the Toledo Simpact. No complicated cam parts to clog with dirt and wear.



3-CHUCK JAWS. Toledo Simpact pipe holder with 3-chuck jaws is strong, easy to center, has powerful grip.

Here's your answer

to DEAD-LINE WHIP *on Rotary Rigs*

New Universally-Adjustable
Dead-Line Stabilizers by
Patterson-Ballagh

Dead-Line Stabilizer, Code: DEADEN, for rotary rigs equipped with fingerboards, is your answer to "wear-weary" dead lines. Protect your sensitive weight indicators against shock waves carried by the dead line. This light, easy-to-install aid prevents line wear against the fingerboard and represents the latest development in Dead-Line Stabilizers. It will more than pay its way by saving wear and tear on expensive equipment.

Mid-Continent operators, here is your Dead-Line Stabilizer, code: DEAR. Adjustable to most rotary rigs, this improved Dead-Line Stabilizer also protects the diaphragms and other delicately balanced working parts of the weight indicator from shock and wear. The ball and socket on this "VIBRATION DAMPENER" can be adjusted to any angle, so that the line is neither bent or locked. This permits a steadying effect on the line and insures accurate weight readings. Install a Patterson-Ballagh Dead-Line Stabilizer on your rig today!

PATTERSON BALLAGH · SEAL OF QUALITY · OIL FIELD SPECIALTIES

Specify

PATTERSON-BALLAGH

DIVISION OF BYRON JACKSON CO.

DEAD-LINE STABILIZERS

22 years of service to the oil industry

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All-New and...

Just as Rugged as They Look

There's a new look in heavy duty trucks . . . all-new "H" line GMCs. These great new trucks, in weight ratings from 19,000 to more than 90,000 pounds, pace the entire heavy duty field in styling that adds to the prestige of your business. And they pace the field in design and engineering that give you better performance, lower operating costs, longer life.

Four new gasoline engines offer greatly increased power, in addition to traditional GMC extra value . . . famous four- and six-cylinder GM 2-cycle Diesels have higher compression for even greater agility and economy. New, stiffer, straight side rail frames, new wide-track axles, new broad-beam, extra comfort cabs . . . new features by the score make all-new GMC "H" models best for all heavy construction and oil field transport. Let your nearest GMC headquarters give you complete details.

GMC TRUCK & COACH DIVISION • GENERAL MOTORS CORPORATION

GMC
GASOLINE • DIESEL
TRUCKS

THE INDUSTRY'S ONLY
BUMPER-BUILT FRONT END

Typical of GMC "H" line ruggedness are angle-braced, frame-mounted radiator grilles with top and sides of spring steel bumper stock, heavy gauge fenders, wide, thick bumpers . . . for complete front end protection, axle to emblem.

THIS BIG JOB...

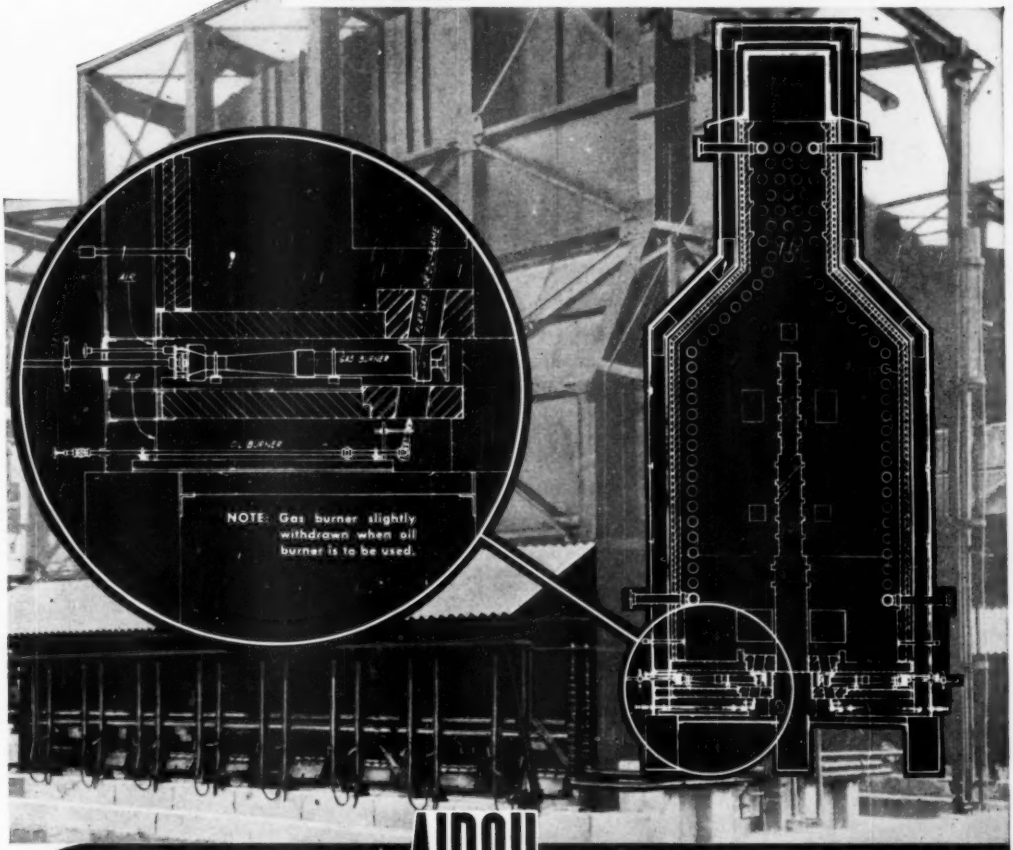
..FIRED WITH 32 SPECIALLY DESIGNED *TANDEM* UP-FIRED OIL BURNER UNITS

Yes, another *special* job by "National Airoil." The two large crude oil heaters, as illustrated, of the floor-fired, center-wall up-draft type, are each equipped with sixteen of our flat flame oil Tandem Combustion Units . . . to obtain an even distribution of heat to all radiant wall tubes with high fuel economy.

And these crude oil heaters have been continuously and easily operated at considerably above their specified designed capacity.

Specializing in the unusual, we of "National Airoil" have a *complete line* of gas and oil burners for any design of up-fired furnace.

Ask us about *your* particular installation or problem . . . we'll gladly comply with full information.



NATIONAL AIROIL BURNER CO., INC.

Main Offices & Factory: **1236 East SEDGLEY AVENUE, PHILADELPHIA 34, PA.**

Texas Office: 2512 South Boulevard, Houston 6

INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

Partial Shipments Only...

Every shipment that leaves the Twin Disc Factory is incomplete . . . only because the *service* that goes with each sale is delivered later . . . whenever and wherever it may be needed.

Twin Disc maintains five factory branches and 47 Parts Stations, strategically located throughout the country, to provide speedy and efficient service.

It is this policy of complete follow-up service that has given Twin Disc products the broad acceptance they enjoy among leading equipment manufacturers. Specify Twin Disc on your next power application.

TWIN DISC CLUTCH COMPANY
Racine, Wisconsin
(Hydraulic Division, Rockford, Illinois)

SPECIALISTS IN INDUSTRIAL CLUTCHES SINCE 1918

"All's well" at the oil well with TIMKEN® bearings in the pumping engine

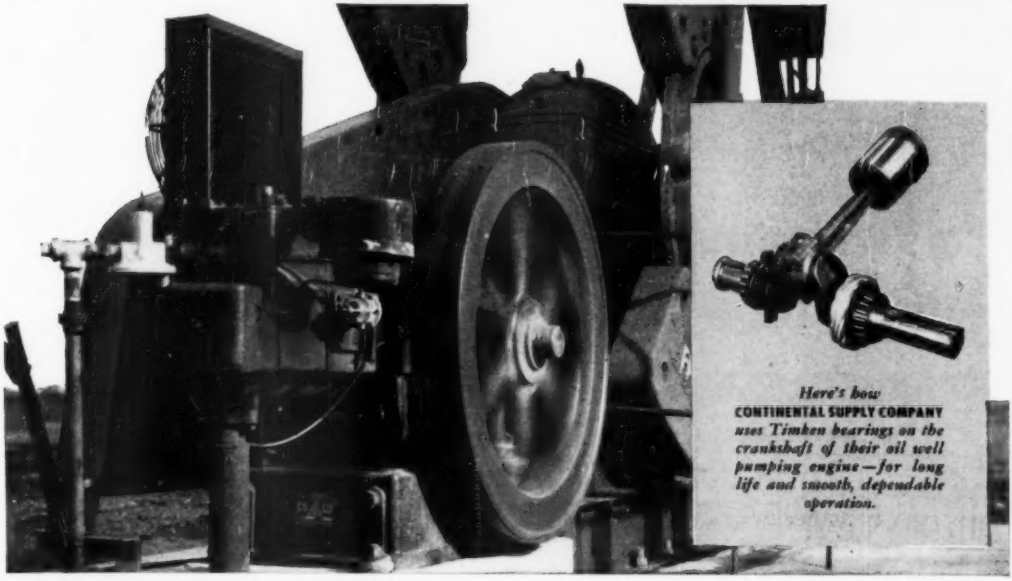
DEPENDABLE pumping month after month with minimum attention and maintenance are assured with this Continental Supply Company pumping engine. One reason is that it uses Timken® tapered roller bearings on the engine crankshaft.

Timken bearings hold the crankshaft and connecting rod in perfect alignment, helping to prevent piston and cylinder wear. Due to their tapered construction, Timken bearings carry both radial and thrust loads in any combination—without deflection or end-movement. Crankshaft wear is eliminated. Smooth, friction-free operation makes starting easier on cold winter mornings and means more power for useful work. And since Timken bearings are designed and manufactured to last the life of the engine, bearing troubles are a thing of the past.

The rolls and races of Timken bearings are made of Timken fine alloy steel for toughness, then case-hardened to give them wear-resisting surfaces. The line contact between the rolls and races provides maximum load-carrying capacity. And because Timken bearings are manufactured to extreme precision and finished to almost incredible accuracy, friction is reduced to a minimum.

The dependable performance of Timken bearings have made Timken-equipped products first choice throughout all industry. Timken bearings in any product are a valuable sales feature that assures customer confidence and acceptance. Whatever machines you build or buy, see that the trade-mark "Timken" is on the bearings. The Timken Roller Bearing Company, Canton 6, O. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



Here's how **CONTINENTAL SUPPLY COMPANY** *uses Timken bearings on the crankshaft of their oil well pumping engine—for long life and smooth, dependable operation.*

WE MAKE OUR OWN STEEL

The special grade alloy steel which gives Timken bearings their strength and resistance to wear, is made in our own steel mills.

The Timken Roller Bearing Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

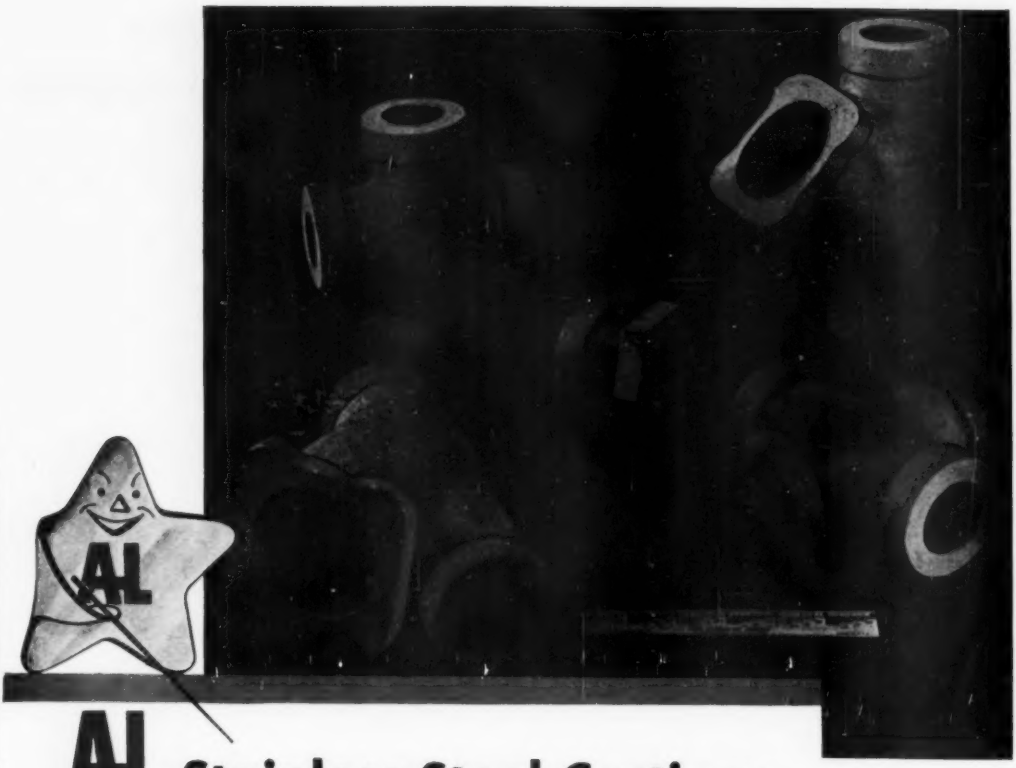
TIMKEN

TRADE MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

TIMKEN 1899 50 YEARS 1949

NOT JUST A BALL ◯ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ⬮ AND THRUST →⬮← LOADS OR ANY COMBINATION ✳



AL Stainless Steel Castings meet any need for Cleanliness

Data on the Uses of ALLEGHENY METAL in Various Industries

Available *now*—informative booklets on Allegheny Metal in the Chemical, Petroleum Refining, Brewing, Meat Packing, and Dairy Industries—others in preparation. Write for this valuable data on the field in which you are interested.

ADDRESS DEPT. O-79

Note the clean, sound, fine-grained appearance of the Allegheny Metal sanitary fittings shown above, in the "as-cast" condition. They're typical of the wide variety of stainless steel castings we produce for the chemical processing, food, dairy, beverage, oil, paper and textile industries, etc.—wherever the purity and quality of products must be maintained, and where ease of sanitation and assurance of long, trouble-free service are prime considerations.

Allegheny Metal castings are produced by methods specially developed to protect uniform quality and guard against defects. You'll find them superior both from the standpoint of machinability and soundness. ● Let us quote on your stainless casting requirements—any shape and any size, from a few ounces to 5000 pounds.

ALLEGHENY LUDLUM STEEL CORPORATION
Pittsburgh, Pa.

Nation's Leading Producer of Stainless Steels in All Forms

W&D 2451

ALLEGHENY METAL is stocked by all Joseph T. Ryerson & Son, Inc. warehouses

HERE ARE ALL THE FEATURES YOU'RE LOOKING FOR

THE CYLINDRICAL PLUG of an a.c.f. type valve needs no lifting from a tapered seat:

- Quick operation, if needed
- A quarter turn—full flow
- A quarter turn—full shut-off
- Straight-through flow—most desirable
- *Round* full pipe area port*—no restriction
- No exposed seats when on flow—no abrasion
- Lubricated—for long life and corrosion protection.

*Can be supplied in rectangular port with full area.

a.c.f. CYLINDRICAL FULL PIPE AREA LUBRICATED **PLUG VALVES**

Representatives in more than 50 principal cities.

Write for catalog 4-OG describing types and sizes to: American Car and Foundry Company, Valve Division, 30 Church St., New York 8, N. Y.

When you protect your equipment against corrosion, it's like putting money in the bank, and you can protect it with RUST-BAN...this is not a single product but a group of protective coatings, each designed to meet specific corrosion problems of oil producers, pipe lines and refineries.

Rust-Ban 323 protects against acid vapors, excessive moisture.

Rust-Ban 327 protects against severe corrosive conditions and resists abrasive action.

Rust-Ban 330 for machinery and for tools.

Rust-Ban 343 protects machined surfaces, threaded parts, castings, forgings, dies.

Rust-Ban 355 protects metal structures in salt water.

Rust-Ban 392 for highly finished precision parts.

Rust-Ban 603 for the interior of internal combustion engines not in use.

Rust-Ban 803-130 for loosening rust and scale.

Rust-Ban 203 for underground gas and gasoline tanks.

RUST-BAN

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Rust-Ban 305 for hot metal surfaces,

Etc., etc., etc. Ask for recommendations for your job.

RUST-BAN is sold by:

Penola, Inc., Chicago, Ill.; Esso Standard Oil Co. of Pennsylvania, Philadelphia, Pa.; Esso Standard Oil Company, New York, N. Y.; Humble Oil & Refining Company, Houston, Texas; The Carter Oil Company, Tulsa, Okla.; Standard Oil Company (Ky.), Louisville, Ky.; Standard Oil Company (Ohio), Cleveland, Ohio; and Imperial Oil Ltd., Toronto, Canada.

This is Why the Nash is the Most Simple Compressor

It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods. Data on these pumps sent immediately on request.

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

Desired delivery temperature automatically maintained.

Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY

322 WILSON, SO. NORWALK, CONN.

be sure... be safe

USE *GENUINE* GARDNER-DENVER PARTS

look for this seal

only Gardner-Denver parts are engineered especially to match the high quality of Gardner-Denver slush pumps

only Gardner-Denver has the authoritative knowledge to give you maximum value in materials and design

only Gardner-Denver has a vital interest in helping you maintain your Gardner-Denver slush pump at peak efficiency

only by insisting on Gardner-Denver genuine parts can you be assured *protected production* . . . the power and stamina for which Gardner-Denver slush pumps are famous.

GARDNER-DENVER TRAINED SERVICE MEN ARE READILY AVAILABLE TO INSTALL GARDNER-DENVER PARTS

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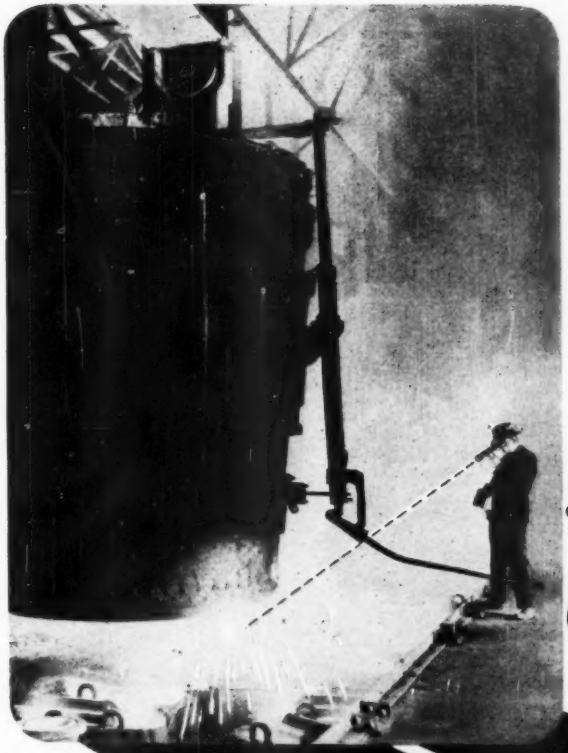
Export Division: 30 Rockefeller Plaza, New York, N. Y.
Republic Supply Co. (of Calif.), 2600 S. Eastland Ave., Los Angeles, Calif.



Quality Controlled

FROM INGOT TO FINISHED PRODUCT

WORTH

Expanded

FUSION WELDED STEEL PIPE

Because Worth Welded Steel Pipe is *expanded* . . . uniform in gauge and quality . . . free from surface defects . . . accurate and uniform in dimensions (allowing for ease in fitting-up and welding) . . . and because, our steel is carefully controlled from ingot to finished product, more and more users of large diameter pipe are relying on it to transmit gas from field to plant and terminal. Worth *Expanded* and Welded Steel Pipe may be obtained in 20", 24", 26", 30", and 36" O.D. diameters—write for detailed information.

Worth also produces Carbon and Stainless Clad Steel Plates, Flanged and Dished Heads

WORTH STEEL COMPANY · Claymont, Delaware

Keeping the Navy "*Ship Shape*" with the Dempster-Dumpster . .

Shipyards, stations, and the men in Uncle Sam's Navy set a standard of cleanliness that is unsurpassed. Helping to maintain this high standard of Navy cleanliness is the Dempster-Dumpster System of materials handling . . . a system of quick pick-up of preloaded containers for hauling, dumping or moving materials.

Exactly 10 years ago the Navy purchased its first Dempster-Dumpster equipment . . . one truck hoisting unit with several containers. Now there are dozens of hoisting units and thousands of Dempster-Dumpster containers of many types at work keeping Navy yards and stations "ship shape." The sturdy steel foolproof and fireproof containers are placed at various places, such as barracks, mess halls, the docks and ship yards, wherever materials (solids or liquids) need be deposited immediately as they accumulate. A Dempster-Dumpster truck hoisting unit quickly picks-up each container when it is filled and hauls it to the disposal area. Contents are automatically dumped and container returned.

If you have a materials handling problem demanding more cleanliness, more economy, and more efficiency, it will pay you to investigate the Dempster-Dumpster System—popularly used, not only by the armed forces, but by municipalities, leading industrial plants, and by large and small institutions of all kinds.

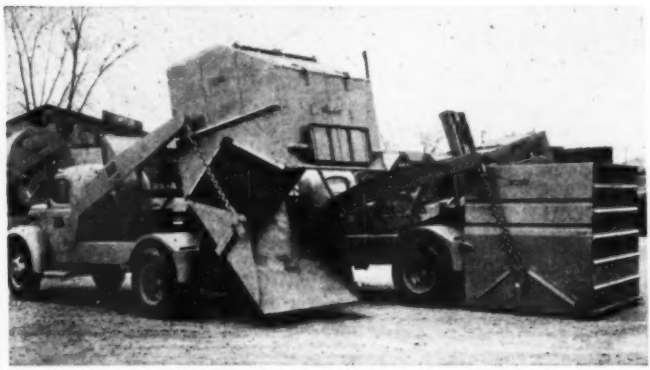


Photo above shows eleven hoisting units recently delivered to the U. S. Navy. Various types of containers are shown in carrying positions. Photo at left shows a hoisting unit preparing to lift a 10 cu. yd. Flat Top container, while another hoisting unit is dumping a 9 cu. yd. Trash and Rubbish Kolector type container. All controls of unit are conveniently located at the driver's seat. One driver and one truck handles any number of containers regardless of types.

DEMPSTER BROTHERS INC.

599 Dempster Bldg.
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Dryer than Death Valley!

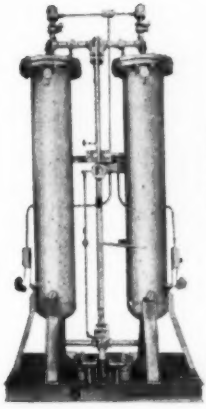
If it is instrument air . . . and it must be bone-dry . . . then the Kemp ORIAD (**O**il **R**efinery **I**nstrument **A**ir **D**ryer) gives positive assurance that the air will be *absolutely* dry at all times.

Because the ORIAD . . . in daily use at oil refineries everywhere . . . dries air to sub-zero dew points as low as −30° F.

Compact, inexpensive, standardized . . . the ORIAD is extremely simple in operation. The unit adsorbs water and water vapor reliably and automatically.

You insure sensitive and accurate response, long life and low maintenance of instruments with an ORIAD installation, and at low cost.

Send for a Kemp representative to tell you about the Oil Refinery Instrument Air Dryer . . . or write for the interesting 48-page catalog on Kemp Dynamic Dryers.



Kemp Oriad Dryer for petroleum industry. Capacity 150 CFM at 100 pounds pressure and 70 degrees F.

The C. M. Kemp Manufacturing Co.
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☐ Please send your representative in to see me.

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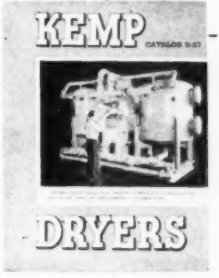

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WHEN TO SPECIFY

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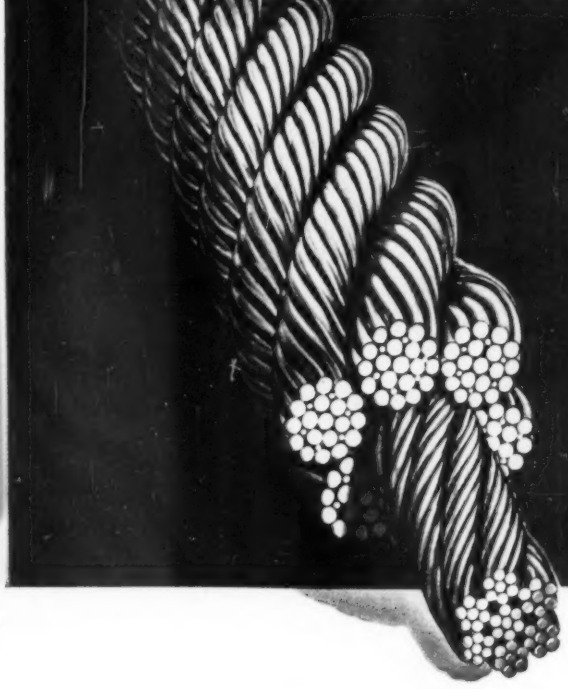
(INDEPENDENT WIRE ROPE CORE)



Preformed "Blue Center" Wire Rope

PERFORMANCE-PROVEN WITH OIL MEN

IN THE TOUGH SPOTS, rope with an Independent Wire Rope Core gives best and longest service! I.W.R.C. is outstanding where operating pressures are high; where heat resistance, additional strength, or minimum stretch are essential. But remember this . . . *the same features that make* I.W.R.C. *best for the tough spots help make it the longest-performing and most economical specification for a wide range of applications!*

As rotary drilling lines, Roebling 6 x 19 Preformed "Blue Center" Steel Wire Rope with I.W.R.C. has demonstrated *extra* life on the job and substantial dollar savings. And, of course, Roebling Preformed construction brings greater ease of handling, top flexibility, less tendency to kink or foul.

Have your Roebling Field Man help select the *right* rope for your special requirements. John A. Roebling's Sons Company, Trenton 2, New Jersey.

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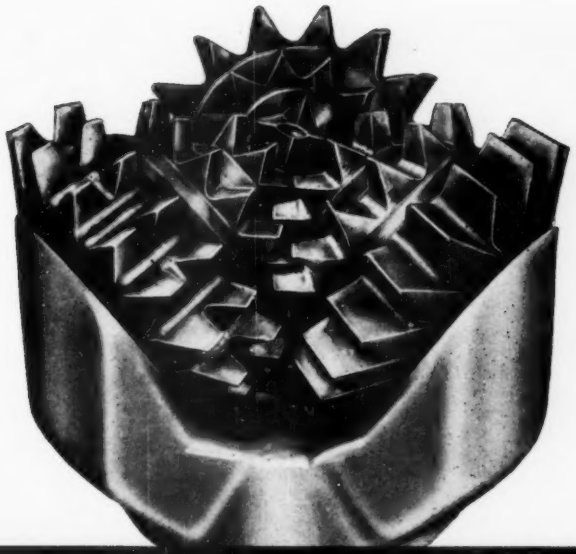

breaking drilling records in soft formations—

Expressly designed for use in the softer formations — such as compact sand, shale, chalk, red bed, salt, etc., commonly found in oil fields — the CP Type ES Three Cone Rock Bit is breaking drilling records for feet per hour.

Built for maximum resistance to hard, abrasive wear, these bits give the long service demanded by modern drilling methods. Cones and bearing journals are of high alloy forged steel, accurately machined and carefully heat-treated, with a special hard facing on the teeth of the cones.

CP bits are designed in the necessary types and sizes to meet the specific drilling requirements in different oil fields. Prompt service is assured in the Mid-Continent and Rocky Mountain fields.

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MANUFACTURED AT FRANKLIN, PA.

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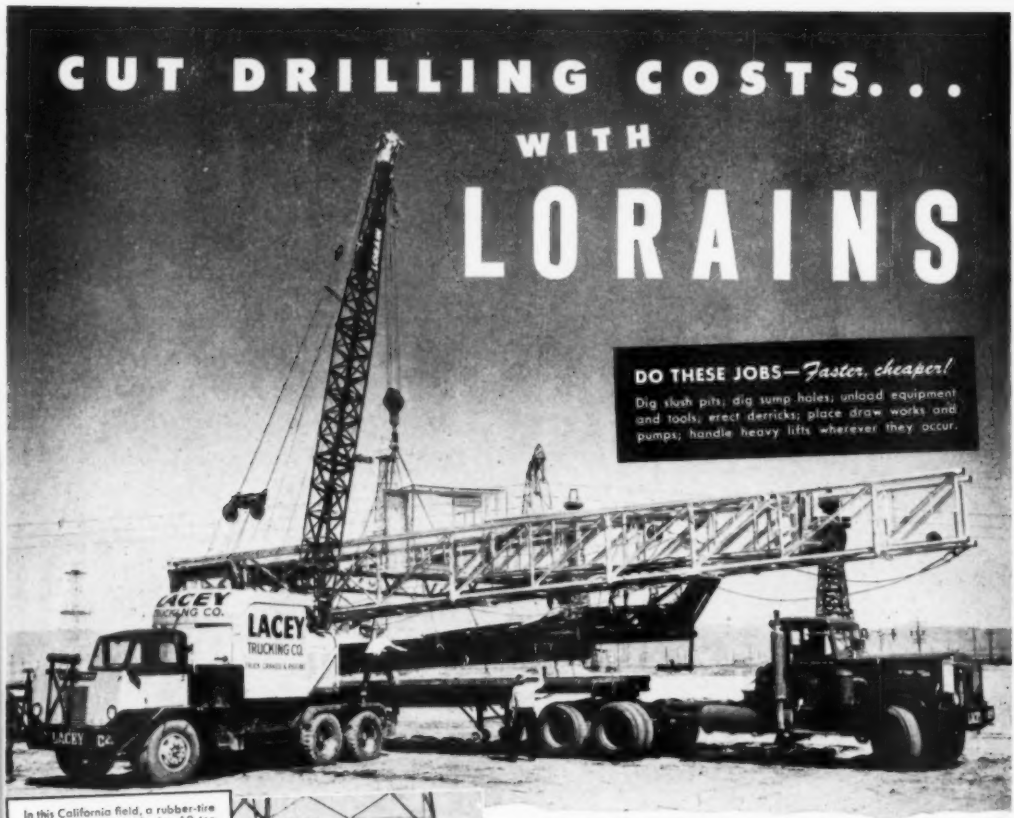
Oil Tool Sales Office: One N. W. 16th Street, Oklahoma City, Oklahoma

CUT DRILLING COSTS... WITH LORAINS



DO THESE JOBS—*Faster, cheaper!*

Dig slush pits; dig sump holes; unload equipment and tools; erect derricks; place draw works and pumps; handle heavy lifts wherever they occur.

In this California field, a rubber-tire Lorain Moto-Crane lifted a 19 ton mast, and walked it to the set-up site. Draw works, pumps and tool houses are also handled easily by Lorains.

This view was taken in the Louisiana oil fields where a crawler-mounted Lorain-TL was working as a dragline digging slush pits.

These pictures show but two of the hundreds of jobs and ways on which Lorains are daily serving the Petroleum Industry with cost-cutting, time-saving performance, in field after field.

Oil field jobs and conditions vary. Some jobs require a machine that will float on top of mud and muck; others need a machine that will move around quickly and travel long distances between jobs.

But no matter how conditions vary, all jobs can have the same standard of high efficiency by using a Lorain. You'll find a machine with *everything* you need in the Lorain line of product—a machine of the *proper* capacity for the size of job . . . the *correct* boom for the type of work . . . and the *right* mounting for your ground or travel conditions . . . and every Lorain is loaded down with design and performance features that show up where it counts—in your profit column.

That's why your Thew-Lorain distributor is a good man to know. He can give you the complete Lorain story—can put the *right* machine in the *right* place to do the job *right*. Your name on a Lorain is a good sign your job is making money. Check the Lorain story today!

THEW-LORAIN 1898 50th ANNIVERSARY 1948

THE THEW SHOVEL CO., LORAIN, OHIO

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SHOVELS • CRANES
CLAMSHELLS • DRAGLINES
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Free bulletin—"Lorains—Cost Cutters of the Petroleum Industry." A new free booklet showing Lorain's service and savings in the oil field is now available. Send for your free copy—today!

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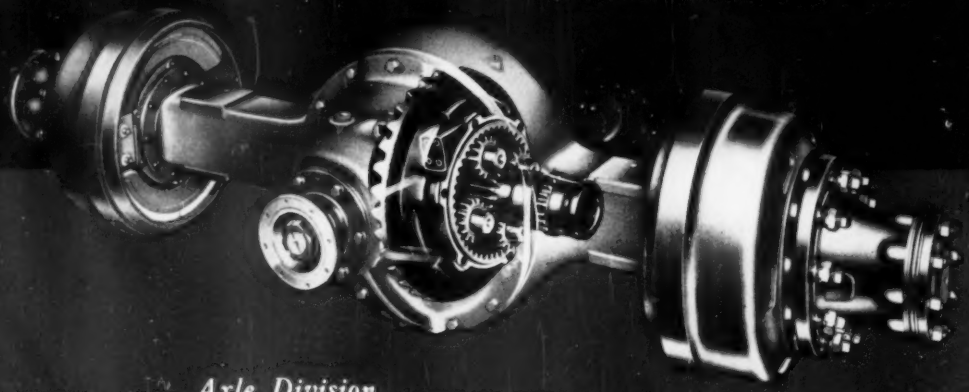
EATON

2-Speed Tandem

AXLES

Eaton's exclusive planetary gearing distributes gear-tooth load, reduces stress and wear on gears and bearings, adds thousands of miles to axle life, holds maintenance costs to a minimum. Slower planetary gear movement makes for easy shifting and silent operation. Available for most trucks of the 1½-ton class and larger, Eaton 2-Speed Axles give extra pulling power combined with high speed; save time, fuel, oil, and engine wear. *They more than pay for themselves.* Ask for a road demonstration . . see the Eaton advantages for yourself.

More Than a Million Eaton 2-Speed Axles in Trucks Today



Axle Division

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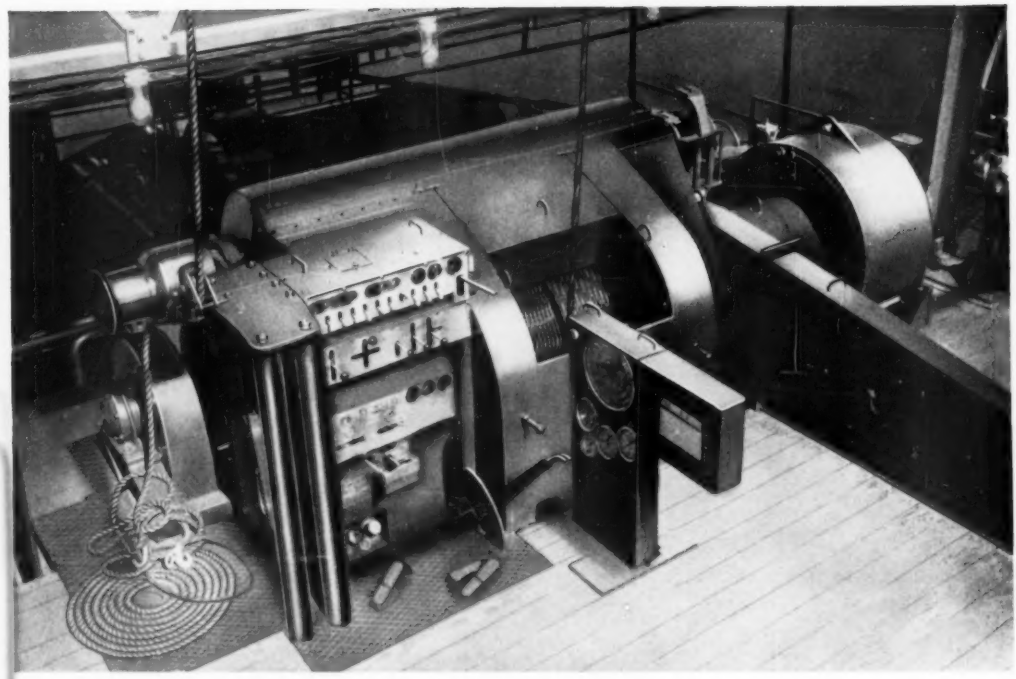
PRODUCTS: SODIUM COOLED, POPPET, AND FREE VALVES • TAPPETS • HYDRAULIC VALVE LIFTERS • VALVE SEAT INSERTS • ROTOR PUMPS • MOTOR TRUCK AXLES • PERMANENT MOLD GRAY IRON CASTINGS • HEATER-DEFROSTER UNITS • SNAP RINGS • SPRINGTITES SPRING WASHERS • COLD DRAWN STEEL • STAMPINGS • LEAF AND COIL SPRINGS • DYNAMATIC DRIVES, BRAKES, DYNAMOMETERS



Speed Up Round Trips with Frictionless Magnetic Braking

The Dynamatic Drawworks Brake is completely magnetic; no friction or wear; no brake blocks or bands to replace. Proved by outstanding records in all fields, including off-shore operations.

- Simple as a light circuit.
- Precision control from driller's position.
- Operates on ordinary light plant current.
- High torque at low speeds.
- Sets slips on heaviest strings without friction brake.
- Readily applied to all rigs—large or small. Can be installed in the field.
- Sold with unconditional guarantee of satisfaction.

Dynamatic Drawworks Brakes are available from drawworks manufacturers and their distributors. Write for illustrated literature.

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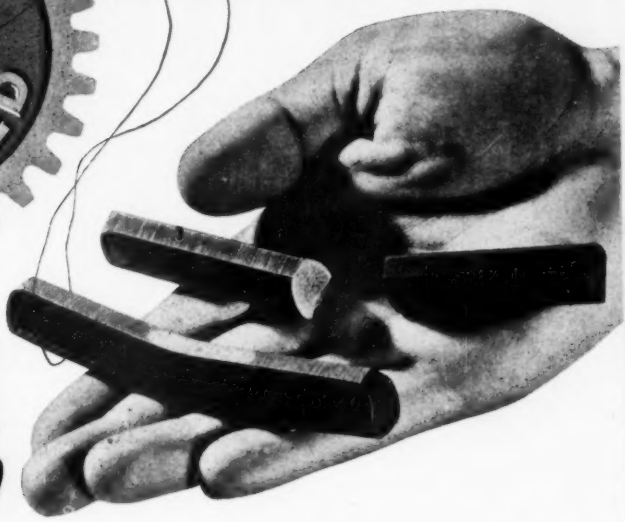
YOU CAN BE **SURE**.. IF IT'S

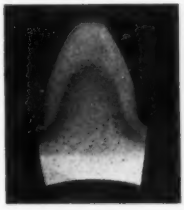
Westinghouse

TAPER-HARDENED



Hard and Tough

this "taper-hardened" tooth bends before it breaks



Taper-Hardened Tooth Section

Case-Hardened Tooth Section

The taper-hardened tooth above bent under the same force that snapped the case-hardened tooth. Yet a test will show wearing surfaces of nearly equal hardness.

The cross sections at the left show why taper-hardened gears have resilience and life under their hard surfaces—why they last longer in punishing service—why they "roll with the punch". Notice the graduated hardness in the taper-hardened tooth—blending down the scale from maximum hardness at the surface to toughness at the ductile core. Compare it with the thin, brittle, shell-like hardness of the case-hardened tooth in which there is no give, no bend.

No wonder "taper-hardened" BP gear steel makes gears last so long.

For complete information on taper-hardening, write for free copy of "BP Gear Steel" B-4395, Westinghouse Electric Corp., Dept. 69, P. O. Box 868, Pittsburgh, Pa.

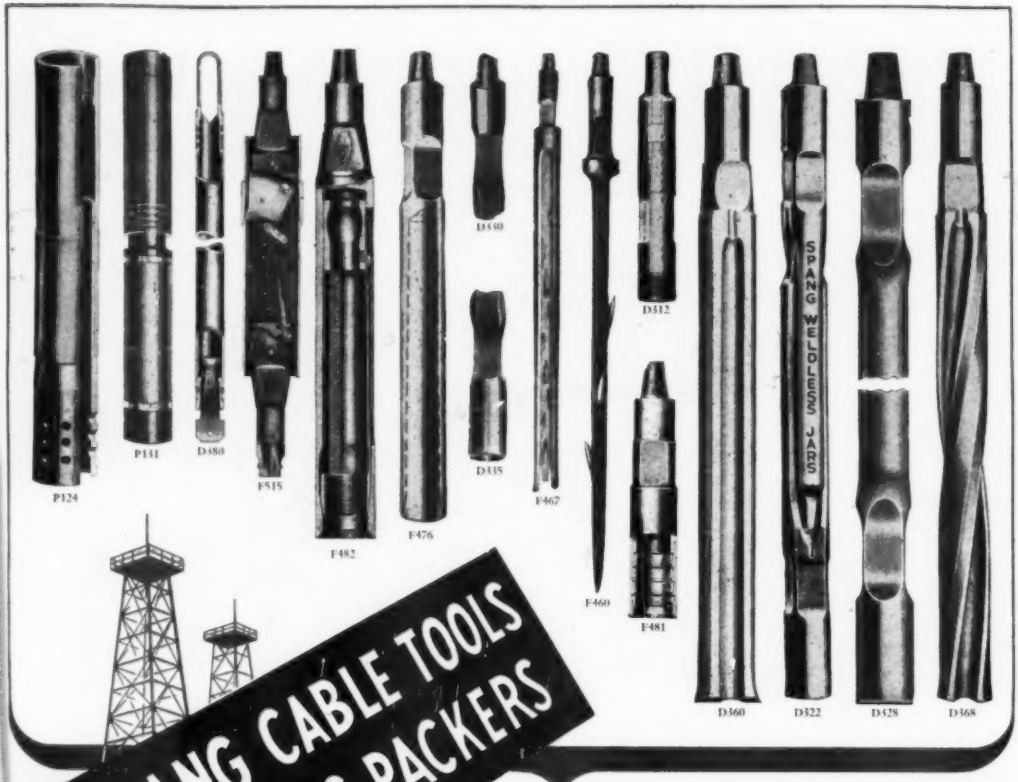
J-07276

Westinghouse

GEARED DRIVES

AGMA

WESTINGHOUSE



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aid modern drilling in All Fields

Spang Cable Tools and Spang Packers have been developed in the belief that the best equipment and the best maintenance result in the most economical drilling. Spang Tools, built for rugged service, are known and preferred the world over. They are available through leading supply companies and field shops everywhere.

Your Favorite Supply Dealer
recommends and sells

SPANG CABLE TOOLS

D312—Swivel Rope Socket
D322—Weldless Jar
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D330—Stem Pin
D335—Stem Box
D360—Straight Drilling Bit
D368—Twisted Drilling Bit
D380—Regular Bailer
F460—Center Rope Spear
F467—Three-Prong Grab
F476—Solid Bored Friction Socket
F481—Multi-Slip Collar Socket
F482—Full-Circle 4-Slip Slip Socket
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Get full details on these Instruments and Services now.
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NOW...Accuracy never thought possible in Taylor's New Force-Balance

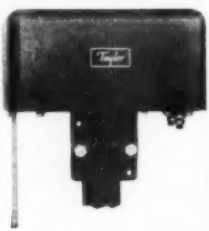
DYNAMIC ACCURACY

DYNAMIC COMPENSATION

DYNAMIC ACCURACY means the accuracy of an instrument in measuring changing or *dynamic* conditions. The Dynamic Accuracy of the Taylor Transaire Temperature Transmitter is of an unprecedented high order. Thus, Transaire becomes the first instrument to solve the problem of many process engineers who realize that an instrument accurate to a fraction of a degree in measuring static conditions can easily be in error by a great many degrees when the temperature is changing.

DYNAMIC COMPENSATION means the ability to compensate for inherent lags both in the measuring system and in the rate of heat transfer of the process medium. This is achieved in Transaire by the introduction of derivative action (Speed-Act) in the *measuring* circuit. The result is *Dynamic Accuracy* of the highest order. This hitherto unattainable speed of response has a profound effect on the results obtainable when temperature is automatically controlled.

* * *



Taylor's Transaire is an entirely new kind of instrument that pneumatically transmits temperature as far as 1000 ft. with an extremely high degree of accuracy. This high accuracy is made possible by these NEW and EXCLUSIVE features.

1. Force-Balance Principle, skillfully employed, provides the means for unexcelled accuracy and unparalleled speed of response.

2. Cigarette-Size Bulb, permitted by force-balance principle, gives unprecedented response to temperature variations due to its low heat capacity.

3. Speed-Act which compensates for lags introduced by a separable well or due to the poor heat transfer of the process medium. Result—the first instrument with *Dynamic Accuracy* under such adverse conditions.

4. Thermospeed Sleeve in separable wells which accelerates heat transfer from the process medium to the measuring system.

5. Barometric pressure compensation, exclusive with Taylor, is vitally important where close temperature measurement and control are essential.

6. Ambient Temperature Compensation cuts to a negligible minimum the effects of fluctuating temperature surrounding the Transaire case and capillary.

7. Standard output pressure range of 3 to 15 psi cuts maintenance, making special calibration of receivers unnecessary.

PLUS:

Easy to install cigarette-size bulb.

Speed-Act Adjustment—Calibrated adjustment makes it easy to match time lag. Chart, based on comprehensive studies of lag rates of many process fluids, is supplied for easy determination of Speed-Act settings.

Faster—63% response in less than 2 seconds in water.

Up-to-1000 feet pneumatic transmission of temperature with extreme accuracy.

Maintenance Minimized by simple, time-proven pneumatic system and use of flexible strip pivots.

Short, shiftable range spans with a simple screwdriver adjustment.

Great Overrange Protection. Overall temperature limits from minus 375° to 1000°F.—with overrange protection to 1000°F.

No electrical hazard in explosive atmospheres.

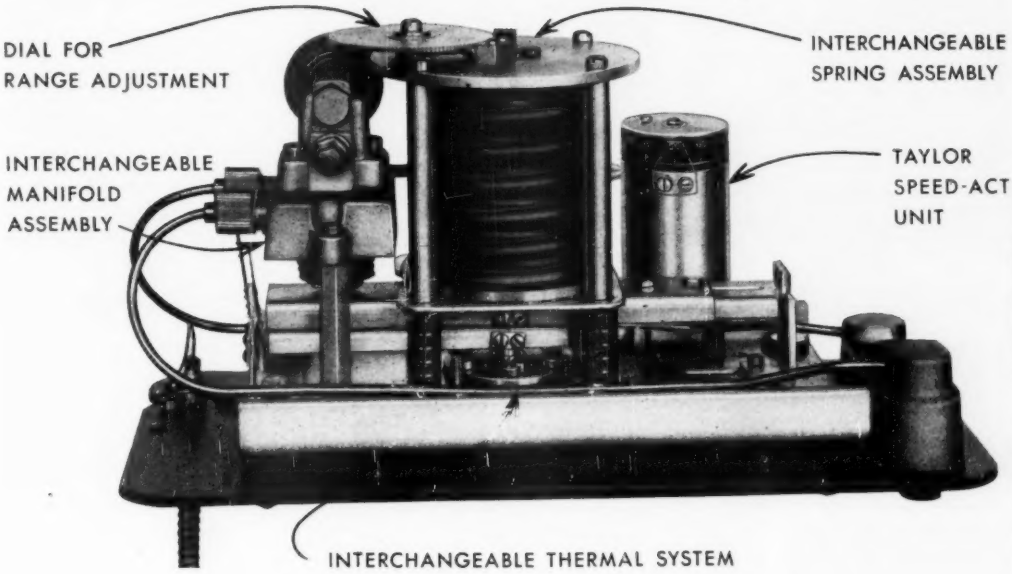
A positive-acting pilot valve, made famous by Fulscope Controllers, assures quick changes in transmission pressure.

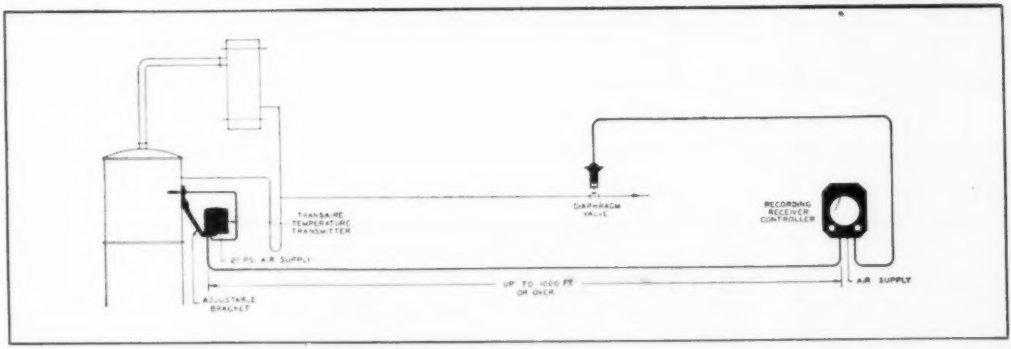
Transaire with Speed-Act is the latest step in Taylor's program to produce industrial instrumentation unsurpassed in *accuracy, simplicity,* and *durability.* Transaire now gives you laboratory accuracy in a production instrument. Ask your Taylor Field Engineer or write for *Bulletin 98140,* Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada. *Instruments for indicating, recording and controlling temperature, pressure, humidity, flow and liquid level.*

process control with TRANSAIRE*

Temperature Transmitter with Speed-Act

* Registered Trade-Mark



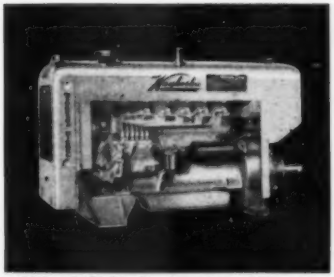


QUICK PICTURE OF DYNAMIC ACCURACY

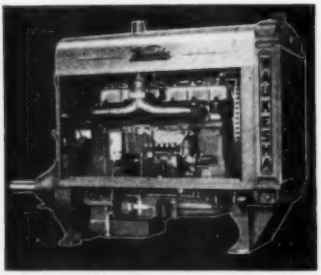
1. Ambient temperature compensation.
2. Barometric pressure compensation.
3. Speed-Act—a derivative action in the measuring system.

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

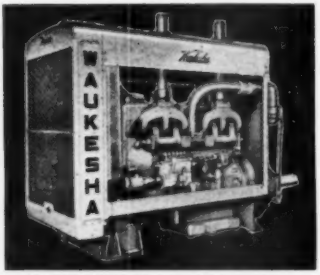
WAUKESHA POWER UNITS
for every oil field service



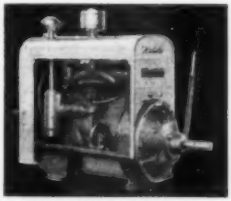
MODEL 190-DLCU—Diesel pumping and utility unit; 25-53 hp.



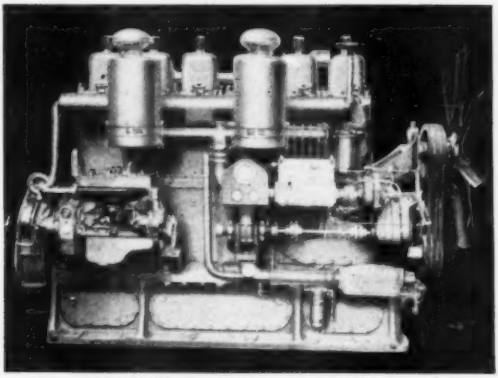
MODEL 148-DKU—Diesel well servicing and cable tool drilling unit; 86-180 hp.



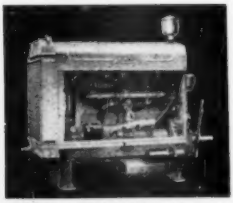
MODEL 6-WAKDU—Diesel drilling unit; 121-210 hp.



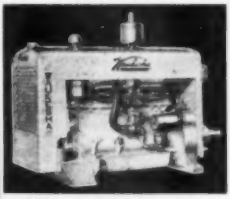
MODEL 180-GLU—Natural gas or gasoline utility unit; 20-32 hp.



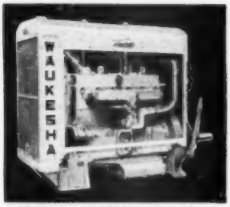
MODEL 6-LRD—Diesel drilling engine; 300-385 hp. max.



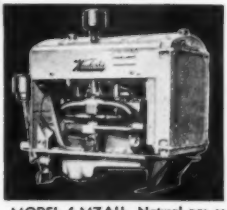
MODEL 145-GKU—Natural gas or gasoline servicing unit; 89-184 hp.



MODEL 190-GLU—Natural gas or gasoline pumping unit; 29-58 hp.



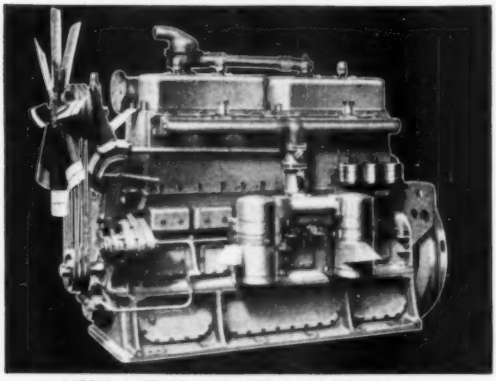
MODEL 6-WAKU — Natural gas servicing and drilling unit; 138-226 hp.



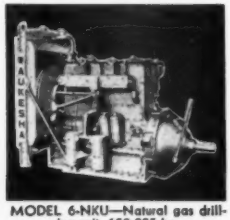
MODEL 6-MZAU—Natural gas or gasoline pumping unit; 40-86 hp.

Whether it is drilling, pipe line pumping, well pumping, well servicing, auxiliary plants, recycling or refinery processing—there's a Waukesha engine or power unit for that particular oil field service.

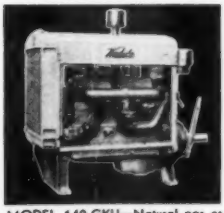
WRITE FOR BULLETIN 1079



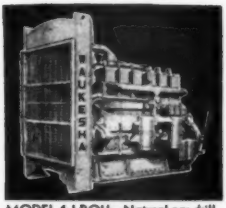
MODEL 6-LRZ—Natural gas drilling engine; 300-460 hp. max.



MODEL 6-NKU—Natural gas drilling unit; 150-225 hp.



MODEL 140-GKU—Natural gas or gasoline servicing unit; 66-130 hp.



MODEL 6-LROU—Natural gas drilling unit; 250-409 hp.

WAUKESHA MOTOR COMPANY, WAUKESHA, WIS. • NEW YORK • TULSA • LOS ANGELES

Another Pittsburgh First!

Gives You Casing Tested in Tension up to 10,000 PSI to Reduce "Leakers" Saves Time and money in the Field

Again Pittsburgh Steel Company is the first to provide a method of adequately testing casing for deep wells to give you fewer leakers and long service with safety. This new development will save you time and money in the field. It is made possible with our new Hydrostatic Testing equipment capable of testing casing *in tension* up to 10,000 PSI.

The new Hydrostatic *Tension* Testing Method is the result of intensive development work on similar equipment first introduced by Pittsburgh Steel in 1939. It was capable of testing at pressures up to 3000 PSI and through years of use proved to be the best method for testing casing ever developed. With the new, heavier equipment Pittsburgh Steel is the only company that can meet your needs for extremely high pressure hydrostatic testing in *tension*. By this method the coupling end of the casing joint is sealed with a threaded plug which is mounted in a floating carriage. The pipe is filled with water and as the pressure builds up to the desired PSI the carriage moves back and the pipe elongates thus avoiding any compression or column stress on the pipe. This permits the internal pressure to act in tension on the area of the plug in the coupling end and closely approaches operating conditions in the well.

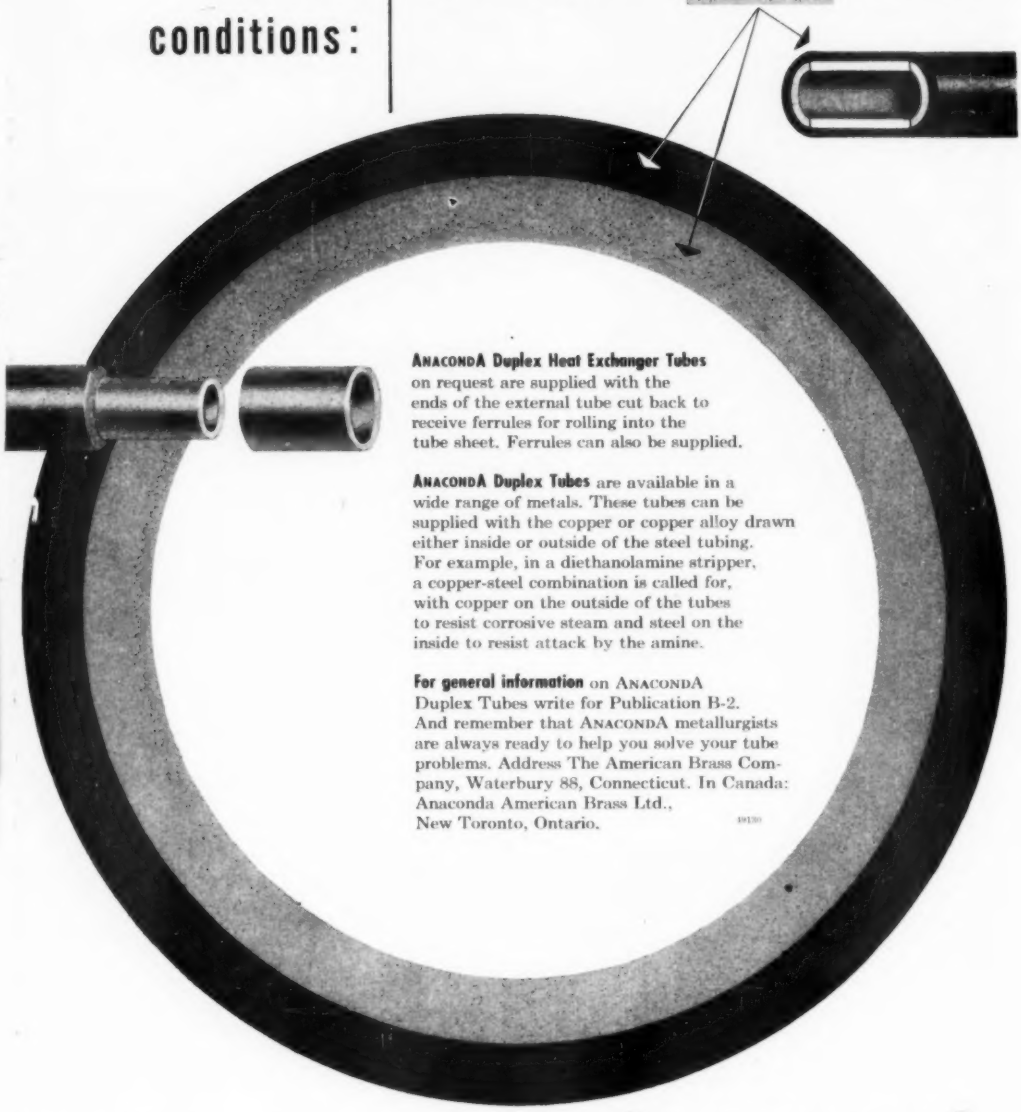
It will pay you to investigate the possibility of having your Pittsburgh Seamless Casing Hydrostatically tested *in tension*. Ask your Pittsburgh field engineer for full particulars or write for information to Pittsburgh Steel Company, Department OG, Grant Building, Pittsburgh 30, Pa.

P

Pittsburgh Steel Company

For special conditions:

Anaconda Duplex Tubes



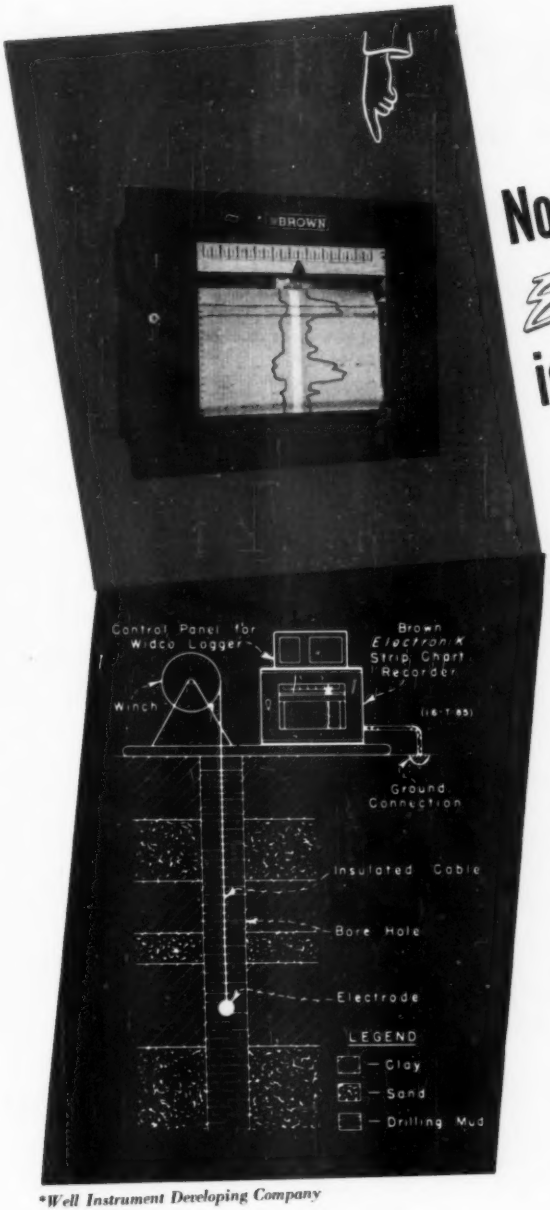
ANACONDA Duplex Heat Exchanger Tubes on request are supplied with the ends of the external tube cut back to receive ferrules for rolling into the tube sheet. Ferrules can also be supplied.

ANACONDA Duplex Tubes are available in a wide range of metals. These tubes can be supplied with the copper or copper alloy drawn either inside or outside of the steel tubing. For example, in a diethanolamine stripper, a copper-steel combination is called for, with copper on the outside of the tubes to resist corrosive steam and steel on the inside to resist attack by the amine.

For general information on ANACONDA Duplex Tubes write for Publication B-2. And remember that ANACONDA metallurgists are always ready to help you solve your tube problems. Address The American Brass Company, Waterbury 88, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

For efficient heat transfer

ANACONDA Heat Exchanger Tubes



*Well Instrument Developing Company

Now the *ElectroniK* is exploring holes...

WITH THE WIDCO* WELL LOGGER...

HERE'S another new application for the now famous *ElectroniK* Potentiometer . . . recording the electrical characteristics of the formations traversed by a bore hole.

No longer is logging hindered by time-consuming mathematics. Resistance and potential are recorded side by side as the sensing device is lowered into the hole . . . and a double check is made during its return to the top. The result is an accurate, automatic log.

The Widco Logger is a self-contained unit, is unusually easy to set up and is extremely simple to operate. The *ElectroniK* Strip-Chart Recorder was selected because of its unmatched sensitivity and ruggedness which make it ideal for severe field usage.

Call in your local Honeywell engineer for detailed information...or write for a copy of Data Sheet #7.0-1.

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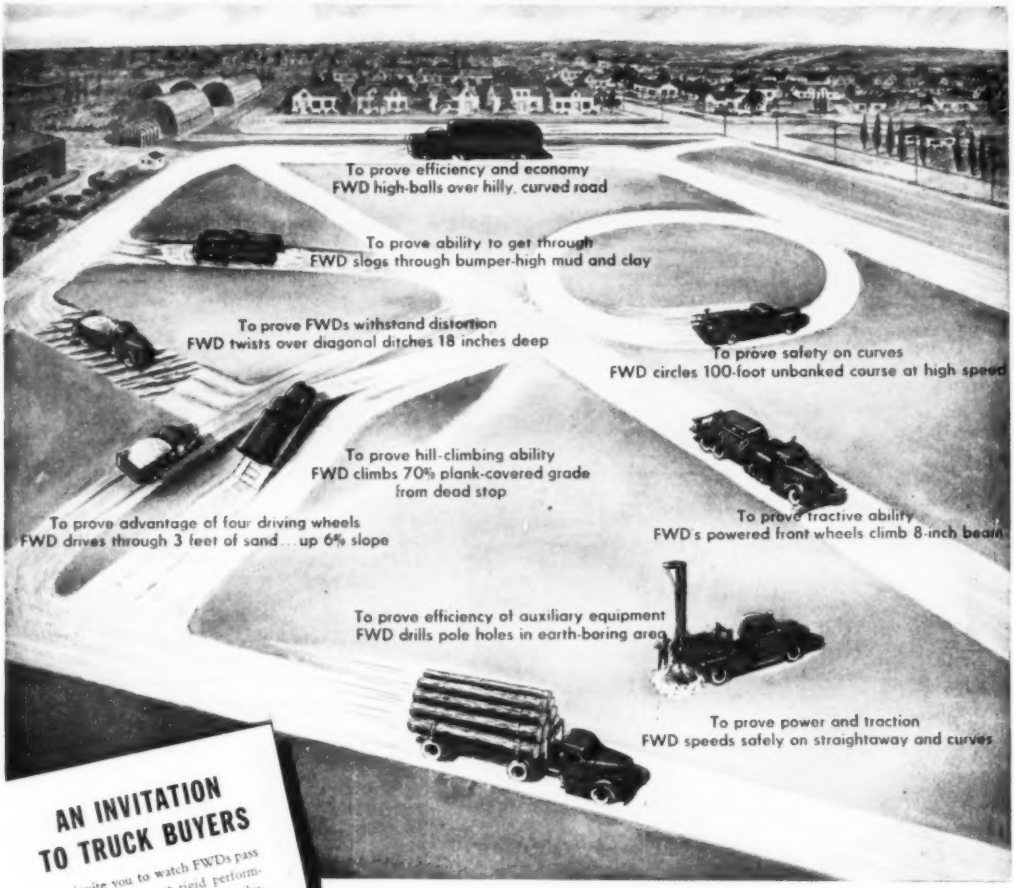
PROOF - *not Guesswork*

Makes FWD America's Foremost Heavy-Duty Truck


To prove efficiency and economy
FWD high-balls over hilly, curved road
To prove ability to get through
FWD slogs through bumper-high mud and clay
To prove FWDs withstand distortion
FWD twists over diagonal ditches 18 inches deep
To prove safety on curves
FWD circles 100-foot unbanked course at high speed
To prove hill-climbing ability
FWD climbs 70% plank-covered grade
from dead stop
To prove advantage of four driving wheels
FWD drives through 3 feet of sand... up 6% slope
To prove tractive ability
FWD's powered front wheels climb 8-inch beam
To prove efficiency of auxiliary equipment
FWD drills pole holes in earth-boring area
To prove power and traction
FWD speeds safely on straightaway and curves

AN INVITATION TO TRUCK BUYERS

We invite you to watch FWDs pass a series of the most rigid performance tests. Ask your FWD distributor to arrange for you to visit our plant. Or — if you can't get away, ask him to show you the movie, *The FWD Story*. In either case, you will see for yourself how FWD trucks can help solve your heavy-duty trucking problems.

Walter A. Olen
President
The Four Wheel Drive Auto Co.

YOU want to know that your truck can climb steep grades . . . drive through deep snow, mud or sand . . . get you through to off-the-road locations. You want to know it can speed heavy loads safely over slippery highways . . . that it can get you around sharp curves without skidding. You want to know your truck has the stamina to insure long life . . . that it will do it without expensive mechanical breakdowns.

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Find out what this can mean to you. See your FWD distributor — or write direct for complete facts about FWD Trucks.

THE FOUR WHEEL DRIVE AUTO COMPANY
Clintonville, Wisconsin
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FOUR AND SIX WHEEL DRIVE TRUCKS

America's Foremost Heavy-Duty Truck

Your Gas Line Freezing Troubles

PARKERSBURG

HYDRACEPTER

PATENTS PENDING

For the PREVENTION of GAS LINE FREEZING

Parkersburg Hydracepter stops gas line freezing . . . cold. By intercepting and removing free water at the point where the maximum portion is in the liquid phase, the Hydracepter eliminates hydrate formation . . . the cause of gas line freezing.

Installed in the line, the Hydracepter actually becomes a part of it. As the gas flows through the scrupper in the upper chamber, water-laden condensate is conducted to the settling chamber (lower vessel) where additional separation takes place. The water-free condensate returns to the upper chamber and on down the gas line.

The lower chamber serves as the float. When a pre-determined volume of water has accumulated in the chamber, the Strain Gauge Pilot, releases pilot gas to open the diaphragm liquid dump valve.

Hydracepter is your best assurance of preventing gas line freezing and costly, troublesome shutdowns during the winter months ahead. Ask your nearest Parkersburg representative for details or write for Hydracepter bulletin 549.

PARKERSBURG RIG AND REEL CO.
Parkersburg, West Va.

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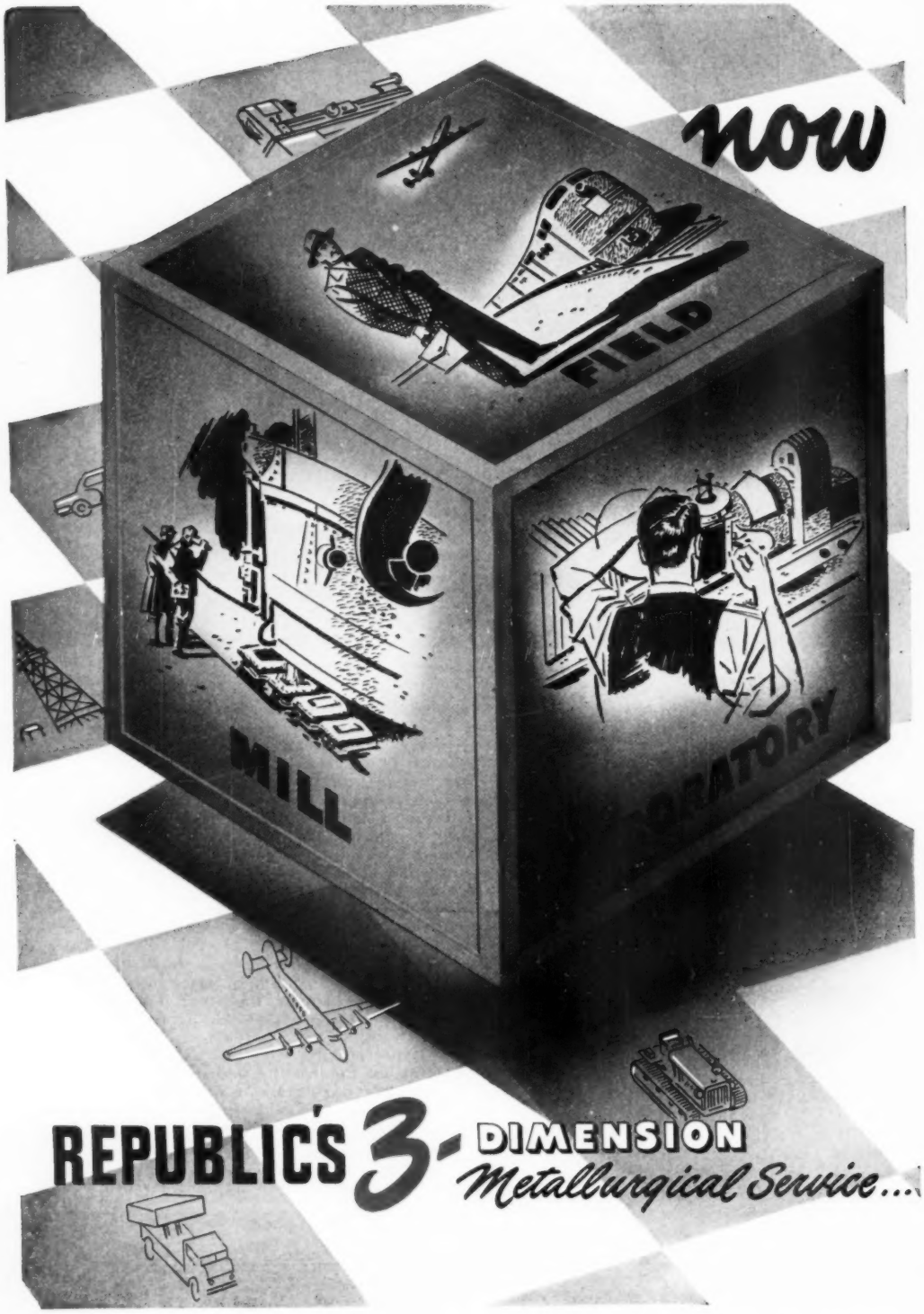
PARKERSBURG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REPUBLIC'S 3-DIMENSION
Metallurgical Service...

it's Your Move!

REPUBLIC'S 3-Dimension Metallurgical Service May Uncover Your Answer to Production Speed-Up —Improved Quality—and Lower Costs!

Unless you are completely satisfied with your product on these three counts: (1) rate of output; (2) quality; and (3) cost of production, your next move in the approaching battle for business should be a complete check-up on the alloy steels best suited to your product, to your processing methods and to your equipment.

In industry after industry, REPUBLIC'S 3-Dimension Metallurgical Service has been matching the correct alloy steel to specific applications for years. Invariably, this problem has been 3-dimensional, too—requiring full consideration for: (1) the effectiveness of the steel and what it can do for the product; (2) the processing necessary to obtain desired results; and (3) the cost of the steel itself.

Here's how this service works: A Republic *Field* Metallurgist, together with your own metallurgists and engineers, studies your problem right in your plant under actual operating conditions. His work then is complemented by and coordinated with that of Republic's *Mill* Metallurgists and *Laboratory* Metallurgists.

The Result: Just the steel you need for every application—quality and salability for your product—high productive efficiency—low unit costs. In other words . . . the most you can get for your money.

Are you wondering what alloy steels can do for you—or if you now are using them correctly? Ask the men who *know—ask REPUBLIC!*

REPUBLIC STEEL CORPORATION • Alloy Steel Division, Massillon, Ohio
General Offices, Cleveland 1, Ohio • Export Department: Chrysler Building, New York 17, N. Y.

to assist you! Republic ALLOY STEELS

REPUBLIC STEEL

"Don't send a boy to do a man's work"

There's a Powell Valve* that's just *right* for every known FLOW CONTROL SERVICE

Most valve failures are the result of misapplication . . . installing valves that aren't of the right design or sturdy enough to do the job for which they are selected. In other words, it's like "sending a boy to do a man's work."

On the other hand, it's a waste of money to specify costly valves for services where less expensive ones may be used. This amounts to putting a man on a job that a boy can do.

To avoid misapplication: (1) standardize on Powell Valves; (2) consult Powell Engineers as to which valves are specifically adapted to each and everyone of your individual flow control requirements.

Powell makes such a *complete* Line* that there is a Powell Valve *exactly* suited to every existing service, from the simplest to the most specialized or exacting. Ask your nearest Distributor—or write direct.

Fig. 1314-A—Class 1500-pound Steel "Y" Valve. Has integral bonnet and welding ends.

Fig. 1561—Class 150-pound Cast Steel Swing Check Valve with flanged ends and bolted cap.

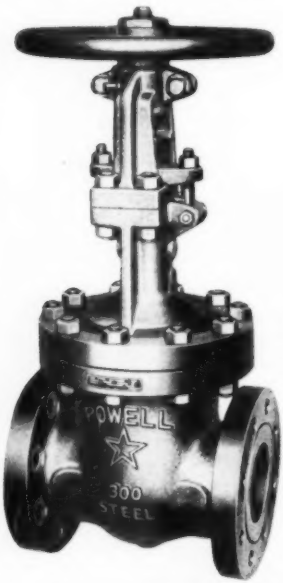


Fig. 3003—Class 300-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke, tapered solid wedge.

Fig. 375 — 200-pound Bronze Gate Valve with screwed ends, inside screw rising stem, union bonnet and renewable, wear-resisting "Powellium" nickel-bronze disc.

Fig. 1708—200-pound Bronze Globe Valve with screwed ends, union bonnet, renewable, specially heat treated stainless steel seat and regrindable, renewable wear-resisting "Powellium" nickel-bronze disc.

*** Powell Valves are made in Bronze, Iron, Steel and a wide selection of Corrosion-Resistant metals and alloys. Valves of every type—Globe, Angle, Gate, Check, Non-return and Flush Bottom Tank Valves—are included in the Complete Powell Line.**

The Wm. Powell Company, Cincinnati 22, Ohio

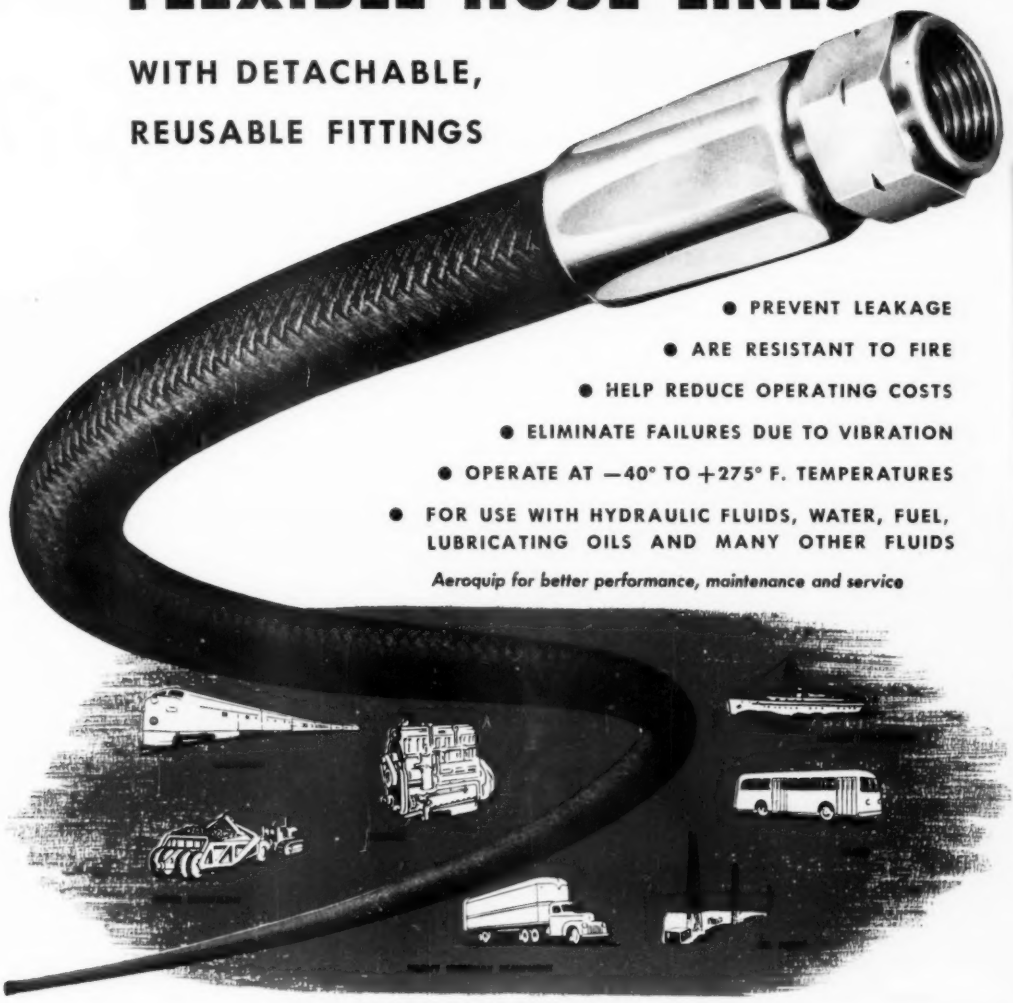
DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

POWELL VALVES

Aeroquip

FLEXIBLE HOSE LINES

WITH DETACHABLE, REUSABLE FITTINGS



- PREVENT LEAKAGE
- ARE RESISTANT TO FIRE
- HELP REDUCE OPERATING COSTS
- ELIMINATE FAILURES DUE TO VIBRATION
- OPERATE AT —40° TO +275° F. TEMPERATURES
- FOR USE WITH HYDRAULIC FLUIDS, WATER, FUEL, LUBRICATING OILS AND MANY OTHER FLUIDS

Aeroquip for better performance, maintenance and service

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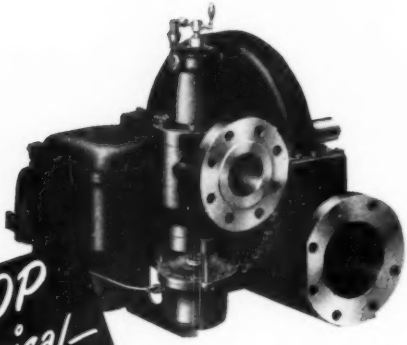
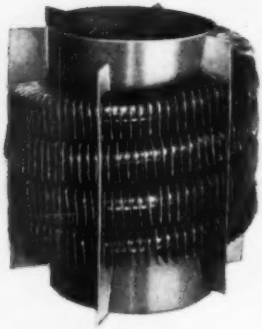


GE Type DP Mechanical-Drive Turbine

SAVE WITH

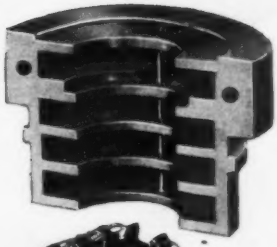
THESE PARTS INTERCHANGEABLE
ON ALL TYPE DP TURBINES! . . .

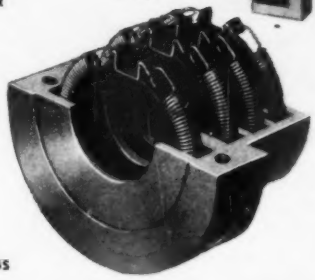
SHAFT, MONEL-SPRAYED AT PACKINGS



HIGH-CAPACITY OIL COOLER

NONSPARKING OVER-SPEED GOVERNOR





DOUBLE-SEAL CARBON PACKINGS

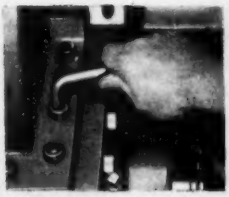
STANDARDIZATION!

IF you operate a number of mechanical-drive turbines, interchangeability of parts can be a mighty potent factor in saving time and trouble when replacements must be made. With the General Electric Type DP you can interchange all the important parts shown—and many more—regardless of turbine size. Also, one low-cost standard spare parts kit serves any DP turbine.

Standardization saves your time when installing or relocating DP turbines too. Common shaft height, regardless of wheel size, permits you to use a standard mounting height. Since all shafts are identical, couplings can be standardized as well.

The new Type DP is not a "standard turbine" for a narrow range of ratings only, but a standardized line, in ratings from 10 to as much as 1200 hp, speeds from 1000 to 5000 rpm. Thus, if your turbine drives fall within this wide range, you can save money—time—and trouble—by standardizing on the Type DP. For full information get in touch with your G-E representative. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

SOLID-BACKED BEARINGS



SOCKET-HEAD CAP SCREWS

TURBINE OIL PUMP

LOW-COST STANDARD SPARE PARTS KIT

GENERAL ELECTRIC

NOW...

Stock delivery of LOW COST ALCOA ALUMINUM HEAT EXCHANGER TUBES

Chances are your local supplier can fill your request for any size or amount of Alcoa Aluminum Heat Exchanger Tube.

That's good news for you. Because at $\frac{1}{2}$ the cost of Admiralty, $\frac{2}{3}$ of cold drawn seamless steel, or $\frac{1}{5}$ of stainless or Monel, Alcoa Aluminum Tubes effectively reduce your new construction and retubing costs.

Want more technical information? Alcoa's free booklet explains aluminum's exceptional corrosion resistance . . . high K factor . . . easy installation. Write for a copy or ask your nearby Alcoa sales office. ALUMINUM COMPANY OF AMERICA, 694-J Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA ALUMINUM

HEAT EXCHANGER TUBES

ALCOA ALUMINUM

INGOT • SHEET & PLATE • SHAPES, ROLLED & EXTRUDED • WIRE • ROD • BAR • TUBING • PIPE • SAND, DIE & PERMANENT MOLD CASTINGS • FORGINGS • IMPACT EXTRUSIONS
ELECTRICAL CONDUCTORS • SCREW MACHINE PRODUCTS • FABRICATED PRODUCTS • FASTENERS • FOIL • ALUMINUM PIGMENTS • MAGNESIUM PRODUCTS

For Larger Gas Engines...

ENSIGN offers New Models

New requirements in both the petroleum and transportation industries call for larger and more powerful engines—hence larger and more compact carburetors.

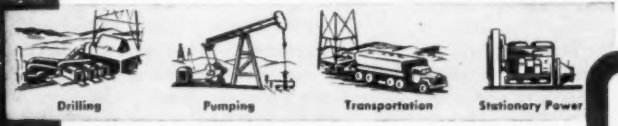
The Ensign model "Dg," a new carburetor for natural gas and butane-propane was laid out in sizes ranging from 2½" to 4" to handle engines up to 500 Horsepower.

Outstanding features of the new "Dg" are:

1. *Built-in fixed orifice economizer for part throttle operation.*
2. *Instant starting, utilizing separate set of gas-air orifices.*
3. *Provisions for balancing air-fuel ratios against air entrance losses.*
4. *Interchangeable venturii for easy adaptation of carburetor to meet wide range of engine operating conditions.*
5. *Universal in application. Updraft or downdraft. Airhorn, throttle tube and entire carburetor movable radially on 90 degree centers. Throttle levers and stops may be used on either side.*

These and other important carburetor features have been carefully worked out to result in finest engine performance in both power and economy.

Engine builders and operators can expect the same high degree of satisfaction and long life from the new Ensign "Dg" line as they have experienced from Ensign carburetors for over 38 years.



Dealers and Distributors in all Principal Oil Fields

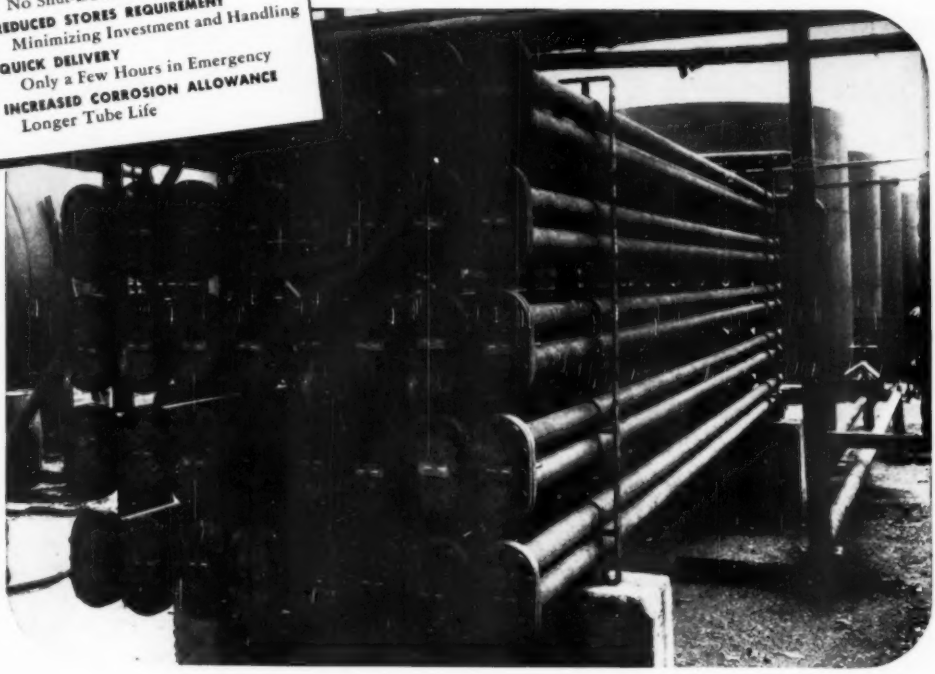
ENSIGN
CARBURETOR COMPANY
7010 S. ALAMEDA ST., P. O. BOX 229
HUNTINGTON PARK, CALIFORNIA
Branch: 2330 W. 58th St., Chicago 36, Illinois

BROWN FINTUBE'S *advantages*

EXTREME FLEXIBILITY
Easily Adapted to Changes in Duty
NO OBSOLESCENCE
Avoiding Waste and Expense
FLANGED HEAD END ASSEMBLY
Eliminating Ground Joint Seals
EASY MAINTENANCE
Using Only Common Tools
CONTINUOUS OPERATION
No Shut-Downs For Cleaning
REDUCED STORES REQUIREMENT
Minimizing Investment and Handling
QUICK DELIVERY
Only a Few Hours in Emergency
INCREASED CORROSION ALLOWANCE
Longer Tube Life

no obsolescence

Brown Fintube Sectional Construction Avoids Needless Waste and Expense



● Brown's interchangeability of parts, exacting design and precision manufacture has "licked" obsolescence.

The sections can be used in one exchanger after another — on different duties — on different products. A bank can even be broken up and the sections shipped to two or more plants, miles apart, assembled and reused. Sections not in use serve as "stores" for other sections on stream. They are *never obsoleted* by changes in duty or plant re-arrangements. You can use, and reuse them, until they are completely worn out.

For the utmost in *efficiency* and *economy*, install Brown's proven, welded fintube heat exchangers throughout your plant. Estimates and quotations furnished promptly. *Write for Bulletin No. 481.*

THE BROWN FINTUBE CO.
ELYRIA, OHIO

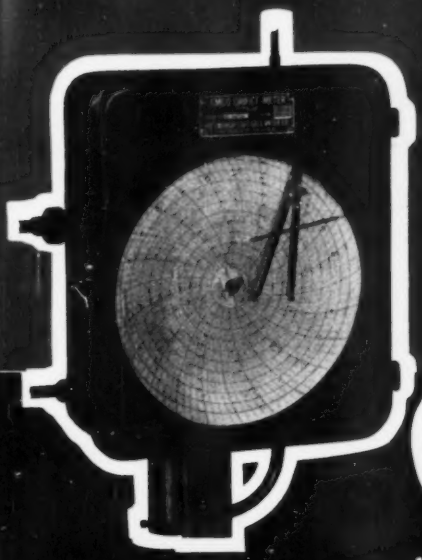
SECTIONAL
HAIRPIN
HEAT EXCHANGERS

ROCKWELL EMCO

ORIFICE METERS

WITH

ROCKWELL CHART DRIVES



ON THE JOB!

EMCO ACCESSIBILITY SAVES TIME AND MONEY

Right on the job . . . and right for the job, too! A favorite with the operating man who appreciates the fully accessible arrangement of parts, the "Speed-Lok" chart hub that never gets lost, the long-lived, accurate Rockwell drive, the chart range tag that identifies the meter chart at a glance, and above all, the service convenience of a design that can be quickly disassembled and built up using common everyday tools.

Management, too, has learned that Emco mechanical advantages pay dividends in the form of greater accuracy and longer life.

For large volume orifice meter measurement at the lowest cost per cubic foot measured—specify Emco!

WRITE FOR BULLETIN 1050

**Other drives available, if specified.*

PITTSBURGH EQUITABLE METER DIVISION
ROCKWELL MANUFACTURING COMPANY
PITTSBURGH 8, PA.

Atlanta Boston Chicago Houston Kansas City Los Angeles
New York Pittsburgh San Francisco Seattle Tulsa

All through-put in the Gladewater, Texas plant of Warren Petroleum Corporation is measured by this battery of Rockwell-Emco meters.

The ROCKWELL-EMCO *Integrator*

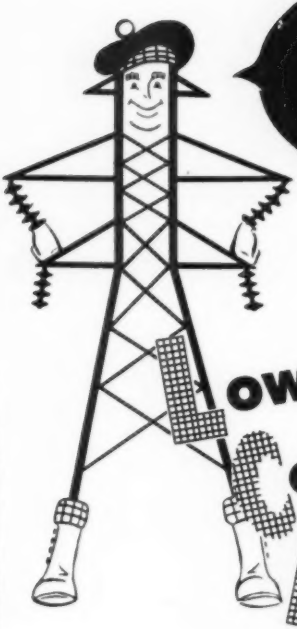
MECHANICALLY COMPUTES ORIFICE METER CHARTS

IMPROVES ORIFICE METER ACCURACY
SAVES ON CHART COMPUTATION COSTS

Rockwell-Emco Integrators mechanically and exactly calculate the extension of orifice meter charts. Assure that the accurate record made by the gauge will be converted into accurate costs. Provide verified record of results. One machine will calculate up to 500 average charts a day.

Write for bulletin 1081.

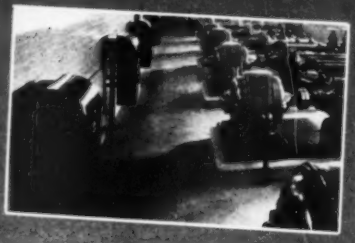
The 1 Right Answer For Every Power Operation



LOW COST POWER

FOR PUMPING

FOR PIPE LINES



FOR REFINING

The tougher the quiz, the better Utility Electric likes it! Before decisions can be reached, the merits of LOW COST POWER* must be thoroughly analyzed. It is out of such surveys that management has switched to LOW COST POWER for pumping, pipeline - transportation, and refining operations. Actual experience has more than borne out advance paper studies . . . in addition to lower cost of power-driven equipment and easier portability, managers report lower maintenance and payroll costs. Let the Power Engineer help you find the best answer for your power operation. Call your nearest Utility Electric Company—make that call now!

*UTILITY ELECTRIC POWER

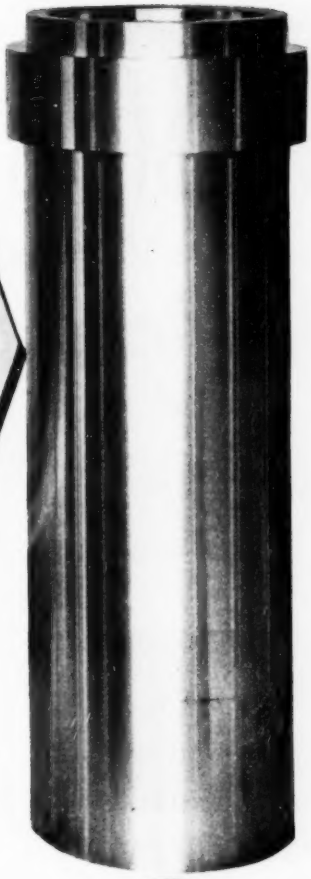
Depend upon Utility Electric Power for all-around efficiency at lowest-possible-cost maintainable by know-how management.

Use Utility Electric Power!

PETROLEUM ELECTRIC POWER ASSOCIATION

Box 1498, Oklahoma City, Oklahoma

The extra life in "TOOL STEEL PROCESS" slush pump liners is equivalent to "stand-by" protection!



Compare these field records:

Fields	"Tool Steel" Liners	Competitive Hardened Liners
Illinois	67,228 ft.	14,231 ft.
Lindsay, Okla.	90 days (av.)	27 days (av.)
Chocolate Bayou, Texas	65,000 ft. (av.)	20,000 ft. (max.)
Texas Gulf	27,000 ft. (av.)	10,000 ft. (av.)
Leeville Field, La.	864 hours	240 hours (max.)
Blue Lake, Texas	40,000 ft. (still in service)	18,000 ft. (max.)

"Tool Steel" precision-made slush pump liners are producing 2 to 4½ times the footage of ordinary liners! This superior service life can be equalled by no other liners!

Wearing surfaces are 650-740 Brinell and are file hard to a depth sufficient for the life of the liner.

Central stocks maintained by our Agents serve the entire Southwest. Immediate shipment on all popular sizes through your regular Supply Store source. Also made to your specifications.

"TOOL STEEL" OIL FIELD REPRESENTATIVES

LYNN ELLIOTT COMPANY, 322 M & M Build.ng, Houston 2, Texas

H. H. KUMLER COMPANY, 1642 East 3rd Street, Tulsa 6, Oklahoma

BUD BRANDEBERRY
Russell, Kansas

Oil FIELD EXPORT OFFICE, E. L. Carter
30 Rockefeller Plaza, New York 20, New York

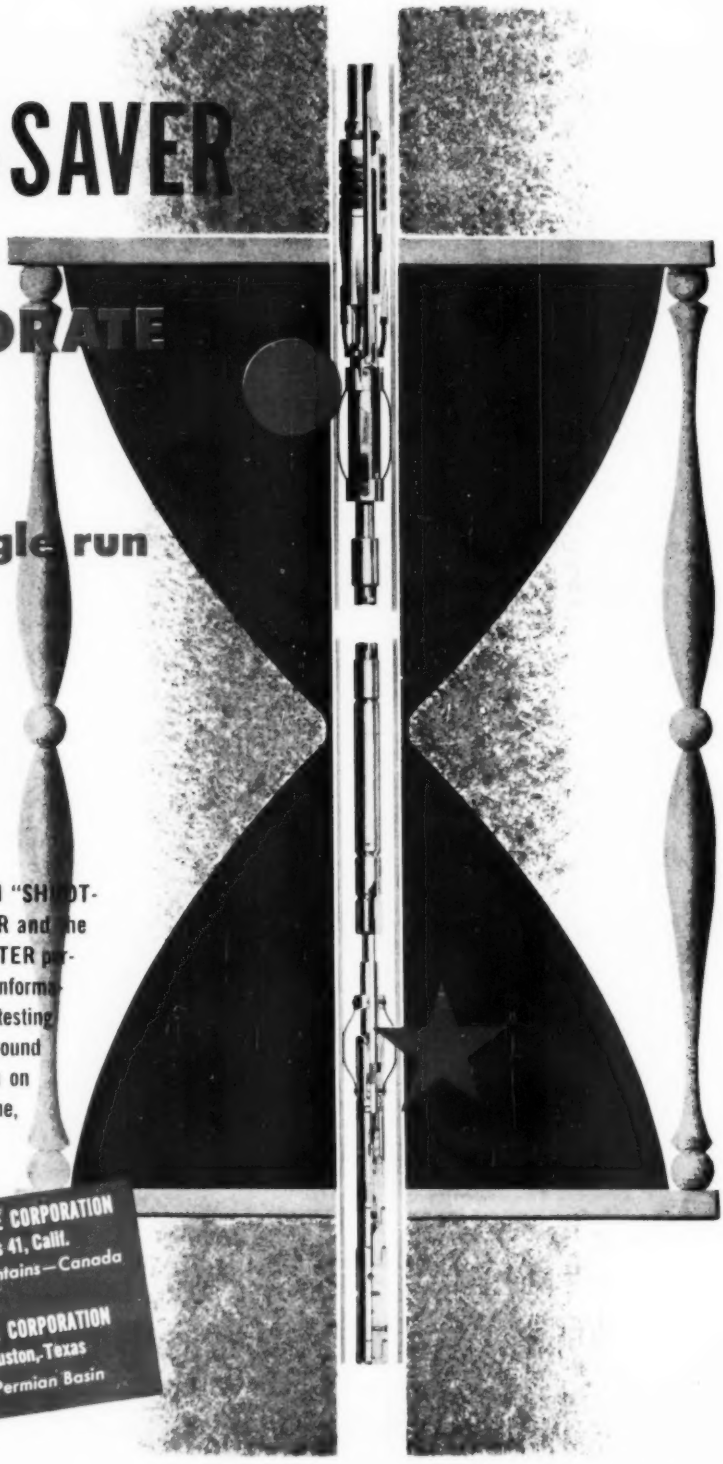
"TOOL STEEL" PROCESS

The Standard of Quality

for LINERS • SPROCKETS • WASH PIPES • SHEAVES *and other* HARDENED PRODUCTS

THE TOOL STEEL GEAR & PINION CO.
CINCINNATI 16, OHIO, U. S. A.

A TIME-SAVER



★ **PERFORATE**
and
● **TEST**
in a single run

SHOOT-N-TEST
Trademark
JOHNSTON FORMATION AND CASING TESTING

When unitized, the JOHNSTON "SHOOT-N-TEST" GUN PERFORATOR and the JOHNSTON FORMATION TESTER perforates, secures water shut-off information, does exploration work or testing for actual production all in one round trip. Write today for information on how this combination saves time, money, and equipment.

M. O. JOHNSTON OIL FIELD SERVICE CORPORATION
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Serving California—Rocky Mountains—Canada

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5702 Navigation Blvd., Houston, Texas
Serving Mid-Continent—Permian Basin

WICKWIRE ROPE

A PRODUCT OF CF&I

Ask any user . . . you'll find them everywhere

In scores of industries, users of Wickwire Rope have developed an affectionate respect for its performance, safety and long life. And, for true economy, they use Wickwire's WISSCOLAY® *Preformed*. It lasts longer — is easier to cut, splice and install. It's kink-resistant and safer to handle. Wickwire Distributors and Rope Engineers, in key cities everywhere, are prepared to render prompt service in meeting your wire rope needs. Wickwire Rope Sales Office and Plant — Palmer, Mass.

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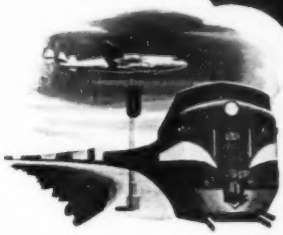
IN THE ROCKIES — The Colorado Fuel and Iron Corp.
Continental Oil Bldg., Denver, Colo.
ON THE WEST COAST — The California Wire Cloth Corp.
1330 — 19th Ave., Oakland 6, Calif.

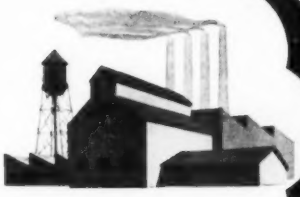
LOGGING



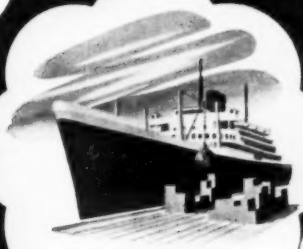
TRANSPORTATION

MINING

PETROLEUM



MANUFACTURING



MARINE

CONSTRUCTION

A. E. Brotman

WITH

GRAVER EXPANSION ROOF TANKS

● Here's a products pipe line terminal where three Graver Expansion Roofs provide the capacity to conserve the vapors in a 27 tank system. *All* the capacity of *all* the equipment is employed, because no venting can occur until all Expansion Roofs reach their maximum height.

Graver Expansion Roofs effectively prevent all breathing or standing losses; and when vapor volumes are balanced during filling and emptying operations, they also eliminate filling losses. In addition, Graver Expansion Roofs offer the advantages of simplicity of design, ease and accuracy of gauging, low maintenance costs, and perfect roof drainage.

Whether it's a single or multiple installation, the Graver Expansion Roof gives you *complete* conservation. Make sure your savings are complete in every respect. Write for facts and figures in full detail . . . today.

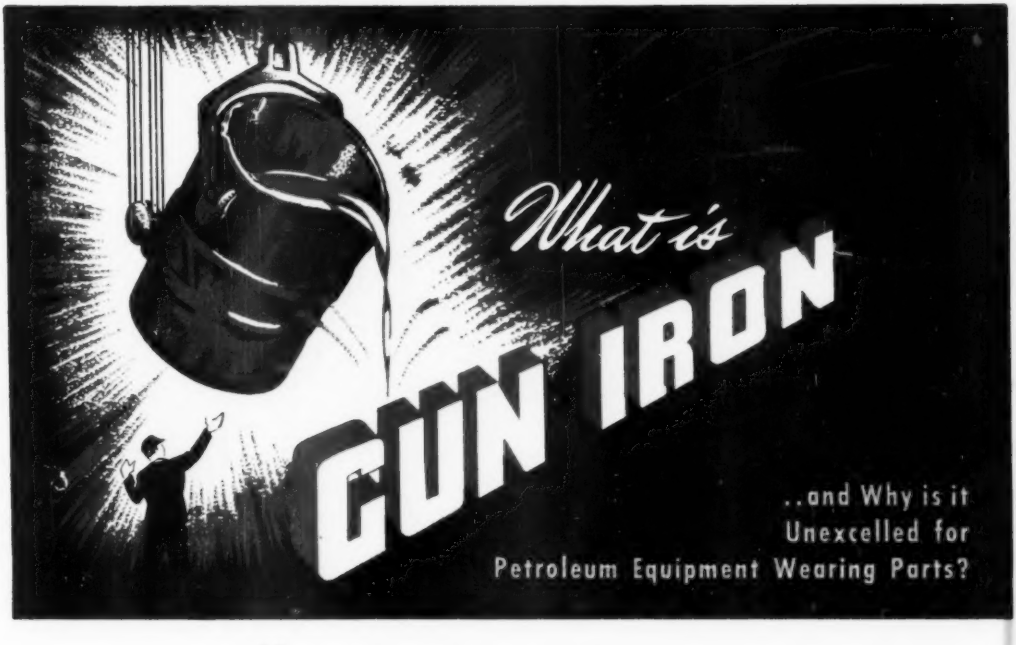
GRAVER

FABRICATED PLATE DIVISION

GRAVER TANK & MFG. CO., INC.

EAST CHICAGO, INDIANA

NEW YORK • PHILADELPHIA • CHICAGO • CATASAUQUA, PA. • HOUSTON • SAND SPRINGS, OKLA.

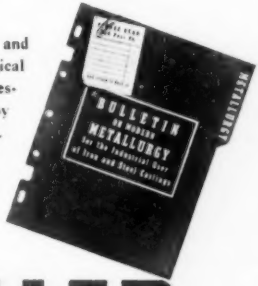


Hunt-Spiller Gun Iron is not new. In fact, its original development dates back to the founding of this company in 1810. Through the years, it became widely known in the production of guns of many types, including the famous Dahlgren cannon mounted on the U.S.S. *Monitor* of Civil War renown. Hence, the adoption of the term "Gun Iron."

In its present form, it is recognized as one of the best materials available for wearing parts in drilling rigs, pumps, compressors, engines and other equipment used in the petroleum industry. Melted in an air furnace (similar to an open hearth furnace), Gun Iron has uniform chemical, physical and structural characteristics . . . a 100% pearlite microstructure. Unalloyed Gun Iron has an average tensile strength of 40,000 PSI, as compared with 30,000 PSI for ordinary gray iron. When alloyed or specially quenched, its strength can be raised to 45,000–50,000 PSI and Brinell hardness increased from 215 to 450-500. Strength and hardness will hold up to 850°F, with a strength loss of only 12% at 900°F.

In its application to parts which are subject to friction—many of which are cast and machined by Hunt-Spiller—Gun Iron's dense, evenly-graphited structure and uniform strength and hardness offer superior resistance to heat, wear and distortion. These same characteristics also assure more consistent machineability in the shop and more reliable and economical performance of the parts in use.

This interesting and highly informative metallurgical bulletin answers many questions as to what metal or alloy is best for specific purposes. Your copy will be sent, without obligation, upon request on your company letterhead.



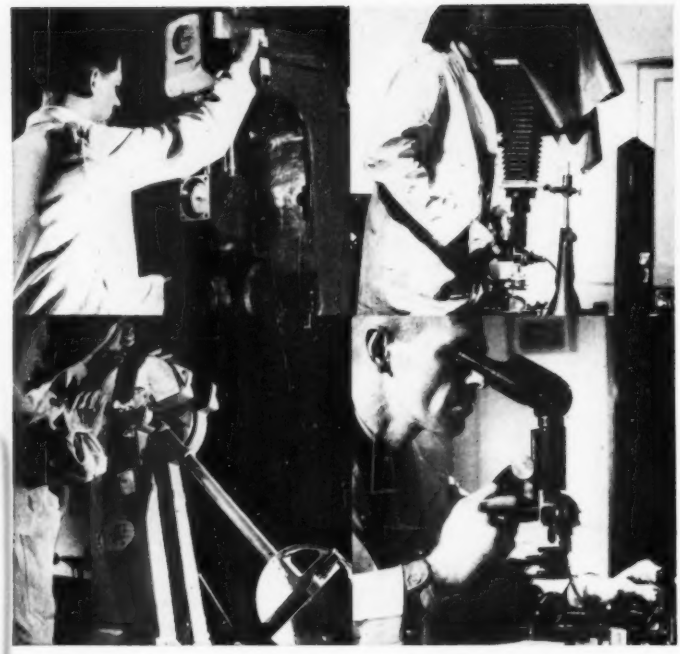
HUNT-SPILLER GUN IRON • AIR FURNACE PROCESS • HSGI

HUNT • SPILLER

MANUFACTURING CORPORATION

393 DORCHESTER AVENUE • SOUTH BOSTON 27, MASS.

Canadian Representatives: Joseph Robb & Co., Ltd., 4050 Namur St., Montreal 16, P. Q.



Raw material control means better Tube-Turn welding fittings

What's a piece of steel made of?

THE quality of a finished product is largely dependent on the quality of the raw material from which it is made. That's why Tube Turns' laboratory technicians thoroughly test every lot of seamless steel tubing received in the Tube Turns, Inc. plant.

Answers to that important question —*What's a piece of steel made of?*— are determined in two ways. First, by chemical tests that disclose the exact percentage of the various elements present in the steel. And, second, by physical tests to determine the steel's tensile strength, yield strength, and elongation. Unless the steel measures up in all respects, the entire lot is rejected.

At the end of these tests, not only is the chemical composition of the steel known, but an accurate appraisal of its metallurgical and physical characteristics has been made. And these facts are filed by the laboratory control number rolled into each fitting to identify it permanently with the lot of steel from which it was made.

This rigid control over raw material is your assurance of basic quality in the Tube-Turn welding fittings you buy. Modern equipment in the hands of skilled technicians permit only the best steel to be used for the manufacture of Tube-Turn products.

Remember, you can always bank on good service in good connections every time you specify "Tube-Turn."

TUBE TURNS, INC.

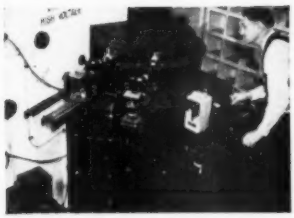
240 East Broadway, Dept. J, Louisville 1, Kentucky

District Offices at New York, Philadelphia, Pittsburgh, Chicago, Houston, Tulsa, San Francisco, Los Angeles

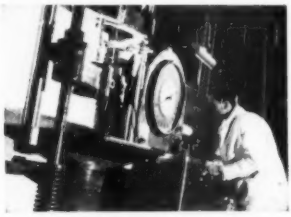
TUBE-TURN

tt

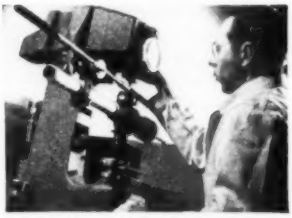
WELDING FITTINGS AND FLANGES



Foolproof chemical analysis of steel is made quickly and accurately on this Spectroscope, typical of the modern equipment used by Tube Turns, Inc. in the control of raw material.



Tensile strength of all seamless steel tubing is accurately measured on this machine, capable of exerting a force of 60,000 pounds. Yield strength and ductility are also checked here.



Periodic checks on the hardness of the steel are made with this Rockwell instrument to determine the strength, ductility, and machinability of the material. Brinell equipment is also used to check hardness.

Advance indication of what will happen to the steel during processing is determined with this electric furnace, one of a battery. Heat treatment to which the material will be subjected is duplicated here.

1

This is the first in a series of interpreted electrical logs from identified formations and fields which Schlumberger will reproduce in this publication. If you would like to keep this entire series, please write to us on your letterhead and we will be glad to send you a reprint of this log and a binder in which you may file subsequent logs as they are published. This series is made possible through the courtesy and cooperation of the oil operators who have released these logs.

LOG ANALYSIS

1) Water saturation S

$R_O = 0.4$ ohm in "X". This value will be used for "B" and "C" sands calculations.

In "B" Sand: $S = \sqrt{\frac{0.4}{29}} = 12\%$ approx.

In "C" Sand: $S = \sqrt{\frac{0.4}{12.5}} = 18\%$ approx.

2) Formation water resistivity R_w

$SP = -90 \log_{10} \frac{R_m}{R_w}$

At water level, in "X", SP = –115 mv.
thus, $R_w = 0.04$ ohm BHT

3) Porosity p

$F = \frac{R_o}{R_w} = \frac{0.4}{0.04} = 10$

$p = \sqrt[m]{\frac{1}{F}} = 28\%$ for $m = 1.8$

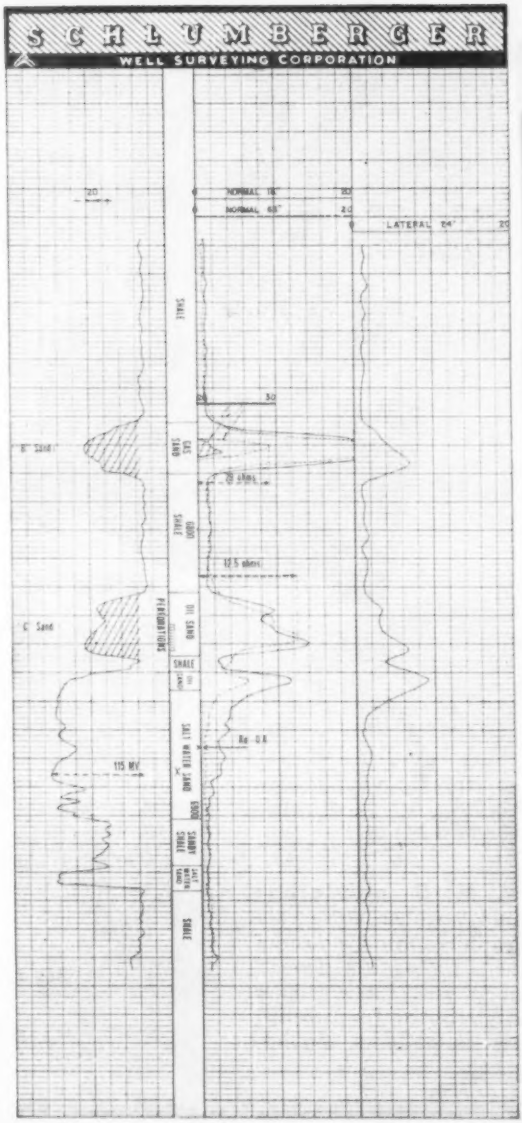
CORE ANALYSIS

B Sand	Porosity	30%
	Permeability	800 md.
	Residual Water	43%
C Sand	Porosity	30%
	Permeability	800 md.
	Residual Water	42%

PRODUCTION RESULTS

Perforated: 6833-42 with 24 shots
Potential: 140 bbl. oil 28.3° API
Gas oil ratio 758/1

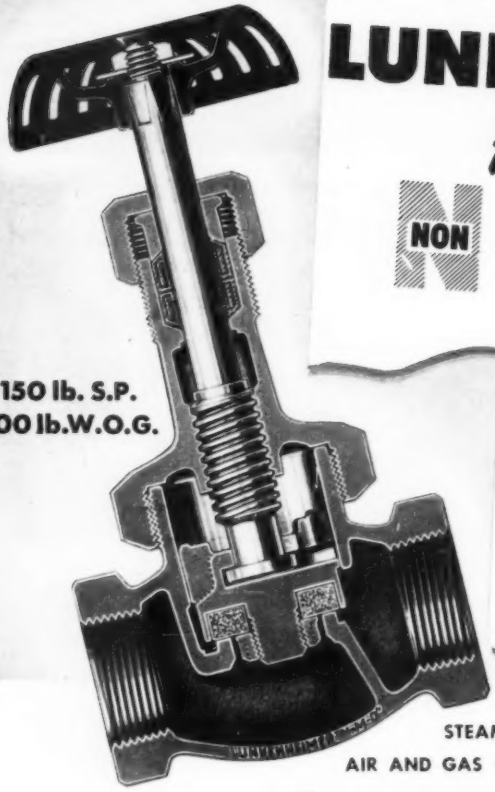
SCHLUMBERGER
WELL SURVEYING CORP.
HOUSTON, TEXAS



A versatile valve for general service . . .

LUNKENHEIMER
Figure 123
N - M - D
NON - METALLIC - DISC

150 lb. S.P.
300 lb.W.O.G.



The valve with the quick-change disc

STEAM • HOT WATER • COLD WATER
AIR AND GAS • GASOLINE • OIL • BUTANE • PROPANE

N. M. D. and other Lunkenheimer Valves are available in all industrial centers. You can depend upon your Lunkenheimer Distributor for prompt service on your requirements.

Fig. 123 is an exceptionally rugged valve . . . available with various types of discs especially compounded to give top results on the services for which they are recommended. Discs can be renewed or interchanged quick as a wink, insuring long-time satisfactory valve service with negligible maintenance expense. Disc holder is slip-on type, perfectly guided. Hexagon head gland is an aid to easy repacking. A further economy feature is the distinctive long-wearing stem material developed by Lunkenheimer, eliminating stem-thread failure due to wear.

The "N-M-D" valve is also regularly available in angle, check and quick operating patterns. Circular No. 558, descriptive of the complete line, is yours for the asking.

ESTABLISHED 1862

THE LUNKENHEIMER CO.

"QUALITY"

CINCINNATI 14, OHIO. U. S. A.

NEW YORK 13 CHICAGO 6 BOSTON 10 PHILADELPHIA 34
EXPORT DEPT. 318 322 HUDSON ST. NEW YORK 13, N. Y.

we take your order

...fill it

...and ship it

quicker

as we fill your order from well balanced stocks maintained in each of our stores, and as each of our store managers has the authority to operate as an individual store.

NORVELL-WILDER

SUPPLY COMPANY

FOR DEPENDABLE SERVICE CALL THE NORVELL-WILDER MAN

SAVES YOU VALUABLE TIME ON ALL ORDERS AND FORESTALLS TROUBLE IN AN EMERGENCY

The ship that helps create jobs in Alaska

From Ketchikan on up the coast . . . in dozens of towns and cities in Alaska . . . people greet the tanker "M. S. Alaska Standard" with considerable affection. For, over the years, she's helped Alaskans develop thousands of jobs.

Regularly she loads a full cargo of petroleum products and takes them wherever they're needed . . . like some giant floating service station. She pokes her prow into rocky inlets to serve fish canneries, goes on up the coast a few miles to bring a new mine the lubricants it needs to work, stocks oil for fishermen so they no longer have to travel six or seven hundred miles to refuel when the salmon run is on.

In short, she helps both the coast and interior of Alaska develop its resources . . . just as the oil industry throughout all our country helps other industries grow and people work, produce and prosper.

STANDARD OIL COMPANY OF CALIFORNIA

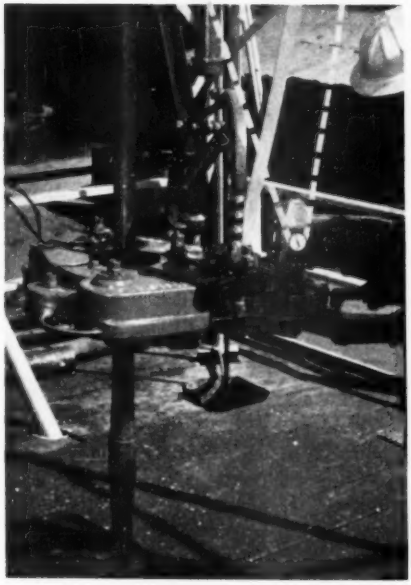
plans ahead to serve you better

NOW.... BJ

BJ's new and exclusive Torque Indicator controls the tightness of the tubing joints and couplings. Gives identical make-up for each joint. Eliminates the costly "down time" caused by guesswork.

POWAIRMATIC TUBING TONG

keeps a 'controlling hand' on your tubing make-up



Byron Jackson Co.
Since 1872
Main Office and Plant: Los Angeles 54, California
Mid-Continent Office and Plant, Houston 1, Texas
Export Office, New York 17, New York
Stocking Jobbers All Principal Oil Fields

POSITIVE CONSISTENT MAKE-UP. Once again, BJ engineering offers an outstanding improvement to safeguard producing and eliminate costly workovers. The BJ POWAIRMATIC now provides a mechanical method of making up tubing joints uniformly. The operator controls the degree of make-up through adjustment of a pop-off valve. The adjustment is based on "Air Pressure vs Torque." This data is contained on a plaque which is conveniently located near the indicator dial. Each joint is made up identically, safe against leaks. Instant releasing of the jaws further insures tight joints and when combined with measured make-up—there is nothing better.

THERE'S NO CHANCE for error; no guessing as to how tight a joint may be. A string made up by a Torque-measuring POWAIRMATIC is set for long service life with minimum cost for production workovers.

FAST... SAFE...The BJ POWAIRMATIC is thoroughly engineered to save equipment, save costly time, and improve safety standards. The most powerful tool of its type, the POWAIRMATIC gives you automatic ring positioning, two-speed operation, easy rollover hanger, quick interchange of jaws... AND NOW, positive control of make-up torque of the tubing joints. See for yourself how the *torque-indicating* method developed by BJ protects your wells by making-up every joint of your tubing to a standard. Jaws—now available to handle couplings on 1¼" through 2½" tubing—either plain or upset. Easily installed to further guarantee a leakproof string. Ask your local BJ representative for a demonstration of the POWAIRMATIC Tubing Tong today.

BJ MEANS ENGINEERED OIL TOOLS

YOUR BIGGEST MONEY'S-WORTH IN OIL...

Comes to You from Competitive Efficiency like this!

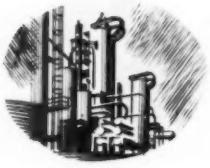
IN SOCONY-VACUUM'S OPERATION,

these major steps—from exploration to delivered product—are carefully co-ordinated to assure maximum efficiency all down the line, maximum savings for you.

First, find the oil—
To satisfy the growing demand, we must maintain a *constant search for new oil*. This in spite of the fact that we purchase large amounts of our crude oil needs from independent producers.

Then drill for it—
Even after oil is found, development of the field entails great cost. New wells must constantly be drilled to replace depleted wells—and so maintain petroleum supply.

Transport it to refinery—
Although we use other common carrier pipelines for transportation, in 1948 Socony-Vacuum laid 3,000 miles of *new* pipelines needed to reach new fields and improve distribution.



Refine it—
by the latest and most up-to-date processes, *geared for high capacity output*. Oil refinery equipment, by the way, which cost the company around $500 a barrel of capacity before the war, now costs $1,000.

Distribute it—
While we own and operate many ships, we also charter vessels and tank cars—rely on common and contract haulers. The combined result—maximum efficiency, lower cost to you.

And finally serve it—
Besides direct distribution, efficiency dictates the use of *over 1,400 independent wholesalers* and some *45,000 independent dealers* to whom of course we give expert technical and marketing counsel.

A STRONG NATION depends on strong Industries . . . strong Industries depend on strong Companies.

Socony-Vacuum — or *any* Company in America — is only as strong as its ability to *compete efficiently* in serving you . . .

. . . with productive power to help build National Security . . . with quality products at low prices to make your dollars buy more.

The Benefits of Competitive Efficiency:

LOW PROFIT PER UNIT—THE MOST FOR YOUR PETROLEUM DOLLAR!

SOCONY-VACUUM

SOCONY-VACUUM OIL CO., INC., and Affiliates: MAGNOLIA PETROLEUM CO., GENERAL PETROLEUM CORP.

Can we give you a hand with your steel problems?

HERE'S A MESSAGE TO EVERY MANUFACTURER
WHO SUPPLIES EQUIPMENT TO THE PETROLEUM INDUSTRY

THE buyers' market is back. That is why you can't afford to overlook any advantage that steel can contribute in making your product more efficient, more durable, less costly to manufacture or easier to sell.

In recent years, new and finer steels have been developed. Faster and more efficient methods of applying steel have been discovered. New uses for steel, either alone or in combination with other materials, have been proved practical.

To bring you this information at first hand, to help you fit the *right* steel to your needs with the least trouble, waste and delay, the expert assistance of our metallurgical contact men is freely available. In addition to their intimate knowledge of the constantly changing steel picture, these men have behind them the facilities of the most completely equipped research laboratories and the finest steel making plants in America. They welcome the opportunity to serve you.

It will pay you to explore the possibilities of these Carnegie-Illinois Products

U·S·S CARILLOY STEELS:—All alloy grades, open hearth or electric furnace; in bars and small shapes, billets, blooms, slabs, forgings, plates, hot and cold rolled sheets, hot rolled strip, structural sections.

U·S·S HIGH STRENGTH STEELS:—U·S·S Cor-Ten, U·S·S Man-Ten, U·S·S Manganese-Nickel-Copper, —in bars and small shapes, tube rounds, plates, structural shapes, cold formed sections, hot and cold rolled sheets, and hot rolled strip.

U·S·S STAINLESS AND HEAT-RESISTING STEELS:—All grades and commercial finishes, in bars and small shapes, tube rounds, semi-finished, forgings, plates, structural shapes, hot and cold rolled strip.

CARBON STEEL:—In axles, bars, small shapes, forgings, plates, rails and track material; semi-finished (including ingots, blooms, billets, slabs, skelp, die-rolled crankshaft blanks, tube rounds); sheets (including cold rolled, galvanized, corrugated, bonded, galvannealed, hot rolled, electrical, copper-bearing, long terne, tack plate, enameling); hot rolled strip; structural sections; Multigrip flooring; bearing piles; steel sheet piling.

USS

CARNEGIE-ILLINOIS STEEL CORPORATION

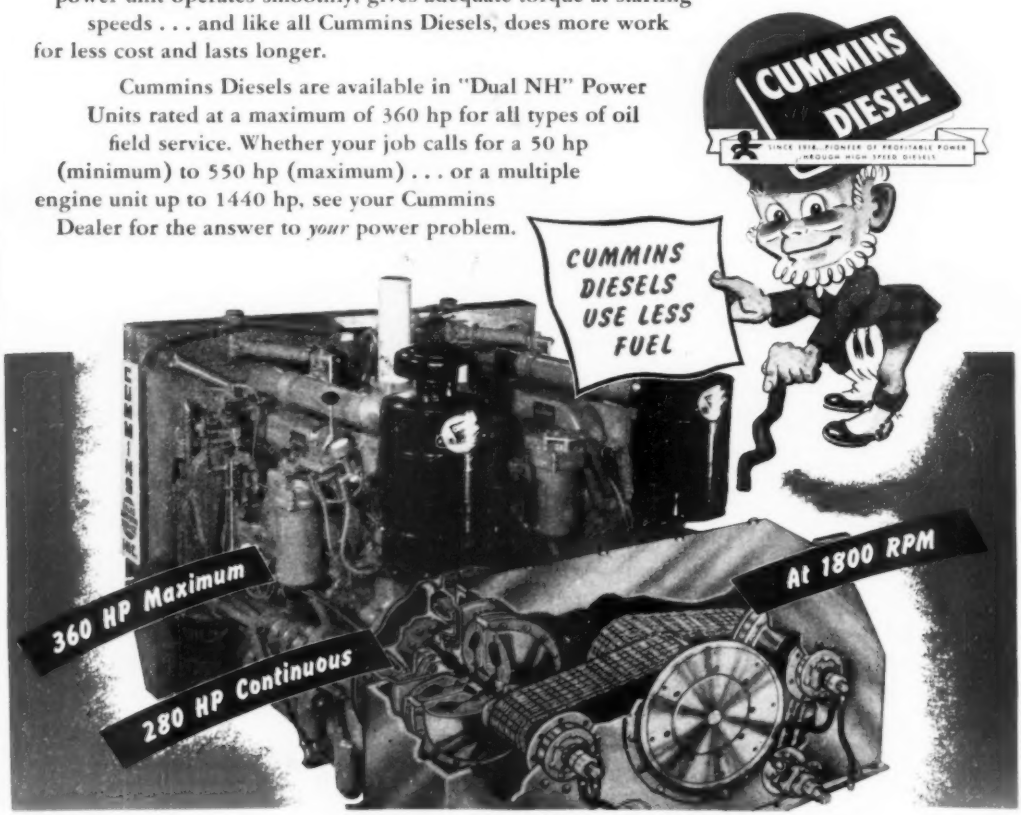
PITTSBURGH · CHICAGO

UNITED STATES STEEL

The new Dual NH Cummins Diesel

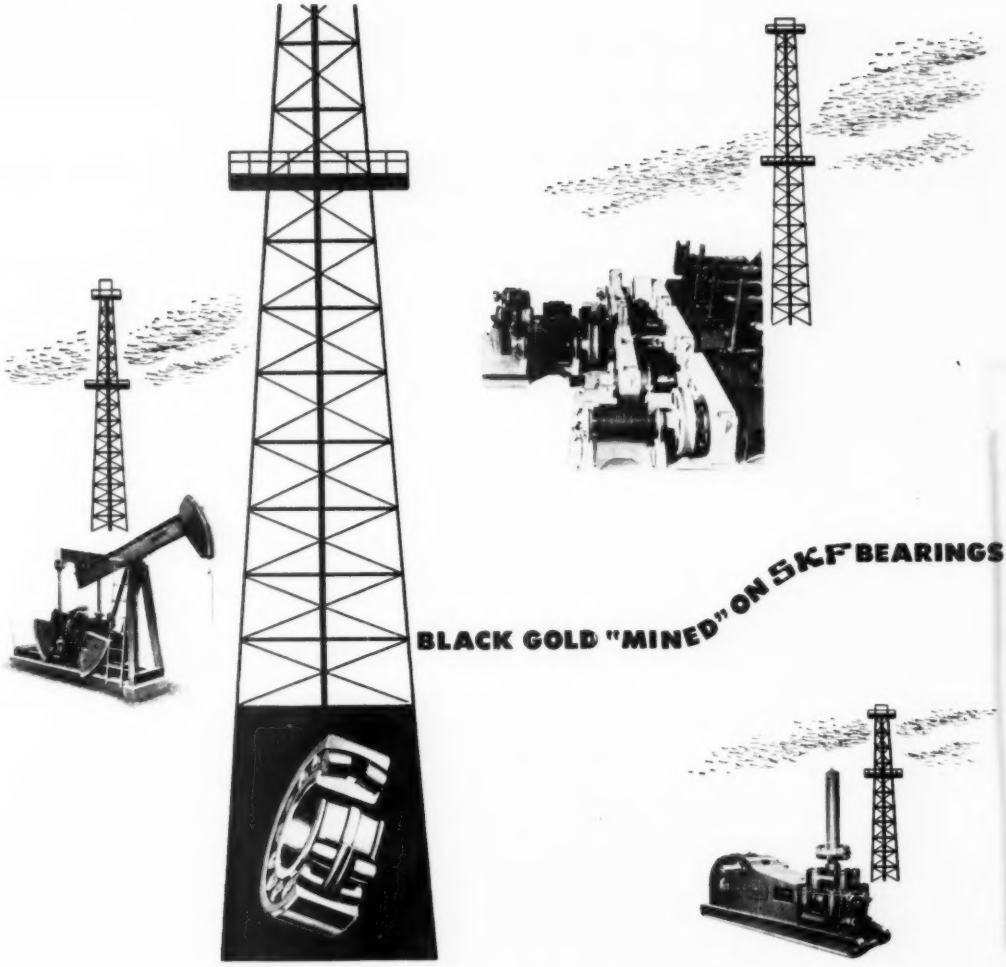
Producing a continuous horsepower output of 280 hp at 1800 rpm, the new "Dual NH" Cummins Diesel Power Unit is a high-speed, two-engine power package equipped with air clutches and fluid couplings. The dual engine power unit operates smoothly, gives adequate torque at starting speeds . . . and like all Cummins Diesels, does more work for less cost and lasts longer.

Cummins Diesels are available in "Dual NH" Power Units rated at a maximum of 360 hp for all types of oil field service. Whether your job calls for a 50 hp (minimum) to 550 hp (maximum) . . . or a multiple engine unit up to 1440 hp, see your Cummins Dealer for the answer to *your* power problem.



SEE YOUR CUMMINS DEALER

CUMMINS SALES & SERVICE, INC. . . . . . *General Office:* Mid-Continent Bldg., Fort Worth 2, Texas, Tel. 3-8785, 2-4485, LD-20
CUMMINS DIESEL SALES OF COLORADO COMPANY . . . . . 2450 Curtis Street, P. O. Box 507, Denver 5, Colorado, Tel. Acoma 5933
CUMMINS SERVICE & SALES . . . . . 1661 McGarry St., Los Angeles, California, Tel. Prospect 1026
CUMMINS DIESEL SALES OF MONTANA, INC. . . . . . 2211-13 Fourth Avenue, North, Billings, Montana, Tel. 8904
CUMMINS INTERMOUNTAIN DIESEL SALES COMPANY . . . . . 1030 Gale Street, Salt Lake City 11, Utah, Tel. 9-3768



BLACK GOLD "MINED" ON SKF BEARINGS

Day-in, day-out oil field equipment takes rugged punishment, yet these industrial units continue to run efficiently. That's where SKF Spherical Roller Bearings play an important part. These bearings are designed and manufactured to withstand the severest operation.

Here's where and why SKF Bearings are specified:

Draw Works: SKF Spherical Roller Bearings give greater efficiency and economy because they provide for misalignment resulting from warpage where a built-up construction is used.

Compound Drives and Transmissions: SKF Bearings accurately locate the various shafts . . . the self-aligning features of the bearing eliminate binding.

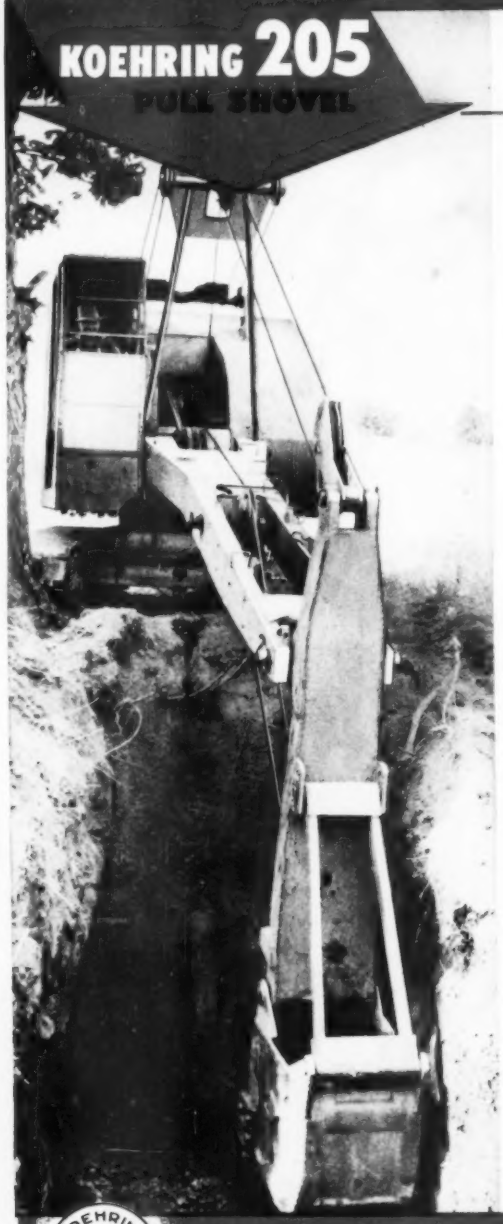
Rotary Tables: The bevel helical gears on pinion shafts call for accurate locating under heavy radial and thrusts loads. SKF Bearings do the job.

Mud Pumps, Shale Shaker Screens, Prospecting Rigs, Well Servicing Winches, Cementing Rigs and Oil Pumping Units . . . all require a bearing that can take it. And SKF Spherical Roller Bearings are preferred by designers. There's an SKF to meet every requirement. Call in our engineers. SKF Industries, Inc., Philadelphia 32, Pa.

6628

Oil Field Equipment Bearings engineered by SKF

HERE'S A POWERFUL PAIR OF TRENCHERS



NO WEAVING with this rigid pull shovel front end

Extra strength, extra resistance to side-sway are built into the Koehring ½-yard 205 pull shovel. You get a straight, clean ditch in toughest oil field digging because this 205 pull shovel is mounted on a rugged heavy crowd shovel boom. Front end will not weave . . . dipper doesn't turn away from the cut, because broad, shovel-type boom point gives a wide connection to the rigid pull shovel dipper arm. Its long, deep digging reach (15'3" below tracks), powerful ½-yard bite, fast swing and easy dumping mean more feet of pipeline trench per day.

dual-purpose boom saves time and money

Because pull shovel and crowd shovel use the same boom, this Koehring 205 combination saves time when you convert from one attachment to the other . . . and costs 20 to 25% less than conventional units that require two separate booms. What's more, crowd and retract cable is self-contained in boom, stays intact when boom is removed . . . saves more time when changing to dragline, clamshell, lift crane or pile driver.

Koehring heavy-duty 205 further assures more production at lower costs because you have independent traction, to travel, swing and operate boom all at same time . . . self-adjusting main clutches for peak operating efficiency at all times . . . choice of crawler, rubber-tired cruiser or truck mounting to suit your exact needs.

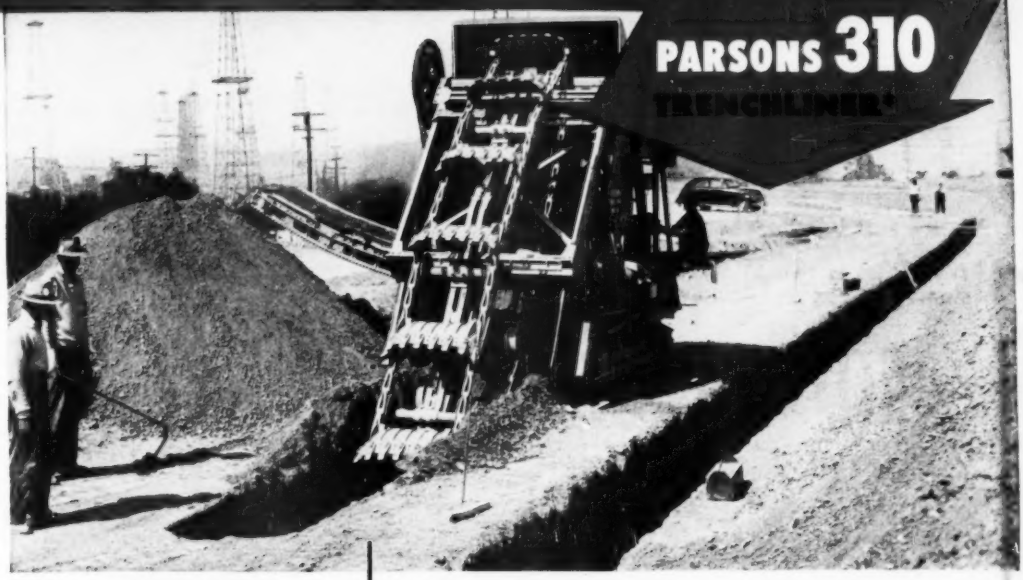
Your local Koehring distributor is experienced in oil field problems . . . will analyze your trenching, excavating and other materials-handling requirements in the interests of greatest efficiency, production and savings for you. See him today about Koehring heavy-duty ½-yd. 205 . . . ¾-yd. 304 . . . 1½-yd. 605 . . . or big 2½-yd. 1005.

KOEHRING HEAVY DUTY

KOEHRING COMPANY - MILWAUKEE 10, WISCONSIN

Subsidiaries: KWIK-MIX • PARSONS • JOHNSON

FOR HEAVY-DUTY OIL FIELD DIGGING



check these **Quick Facts** on what model 310 can do for you:

- **45 DIGGING SPEEDS . . . from 8″ to 186″ per minute . . . plus 5 reverse speeds. Travels 1¾ m.p.h.**
- **7 CUTTING WIDTHS . . . 18″ to 54″. Special side-cutters provide full range with only 4 standard bucket sizes.**
- **TRENCHES TO 15′ DEEP . . . telescopic boom is easily adjusted for quick variation of digging depths.**
- **DUAL BOOMS . . . available for digging 72″ wide . . . at 10 depth.**

Where you need extra rugged digging strength for toughest trenching assignments . . . extra range of digging widths and depths, this heavy-duty Parsons 310 ladder-type Trenchliner can earn important savings for you. Big and tough, with highest quality in every machine detail, Model 310 offers many big-production, cost-cutting advantages:

Maximum digging power is transmitted by roller-chain drive direct to bucket line. Heavy, cast alloy buckets are rib-reinforced . . . teeth are alloy steel forgings, heat-treated to resist wear. Spring-loaded, band-type safety clutch mounted on excavator drive sprocket operates automatically, cushions shock loads, protects machinery from abnormal strain. Digging boom automatically locks in any position to hold grade. Oscillating mounting keeps entire machine on even keel . . . keeps twists and strains from main frame . . . assures uniform ground pressure.

Get all the facts . . . see your Parsons oil-field distributor about this 310 Trenchliner . . . or write for bulletin.

PARSONS COMPANY • Newton, Iowa

Mail today to: **PARSONS Company, Dept. OG, Newton, Iowa.**

Please send bulletins on Trenchliner* models: ☐ 310 ☐ 250 ☐ 221 ☐ 200

NAME..... TITLE.....

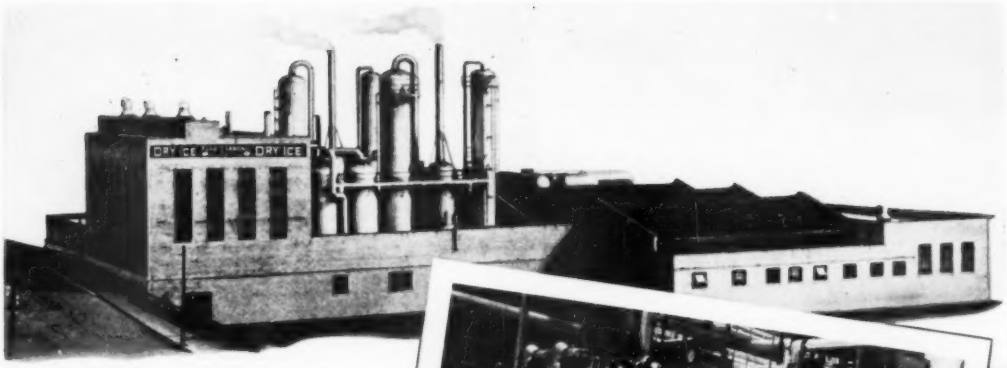
COMPANY.....

STREET.....

CITY..... STATE.....

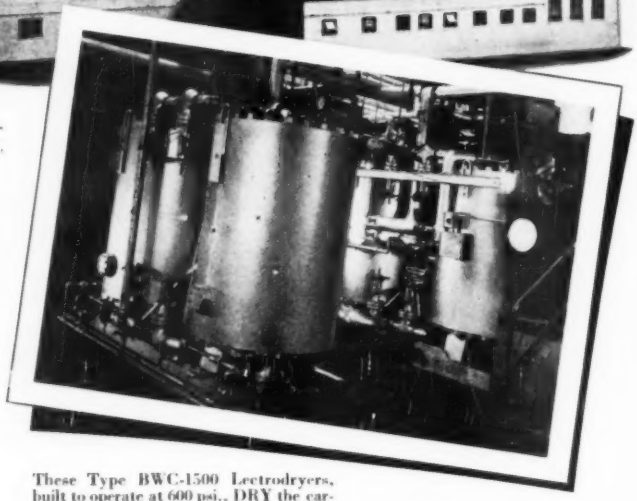
☐ Also interested in utility-size, rubber-tired, 18.5 m.p.h. Trenchmobile.

*Trademark Reg. U. S. Pat. Off. KP922



Pure Carbonic's new Chicago plant for the production of carbon dioxide and "DRY-ICE".

140 TONS OF CO_2 DAILY...



These Type BWC-1500 Lectrodryers, built to operate at 600 psi., DRY the carbon dioxide. Lectrofilters remove oil vapor as the gas comes from the compressors.

dried DRY by Lectrodryers

DRY ICE evaporates without a trace of moisture to mark its passing. Carbon dioxide produced by Pure Carbonic, Incorporated, is free of moisture. That's because the gas is dried DRY with Lectrodryers.

Pure Carbonic, Incorporated, has been using Lectrodryer equipment for many years in all their plants. Their operating men report "excellent performance and minimum maintenance."

DRYing air, gases and organic liquids is helping thousands of companies boost product quality and hold it high. Reactions stay "on the beam" when you're working with materials of known moisture content. Products do not suffer deterioration when stored in DRY atmospheres. DRYing is speeding up production by permitting materials to flow freely.

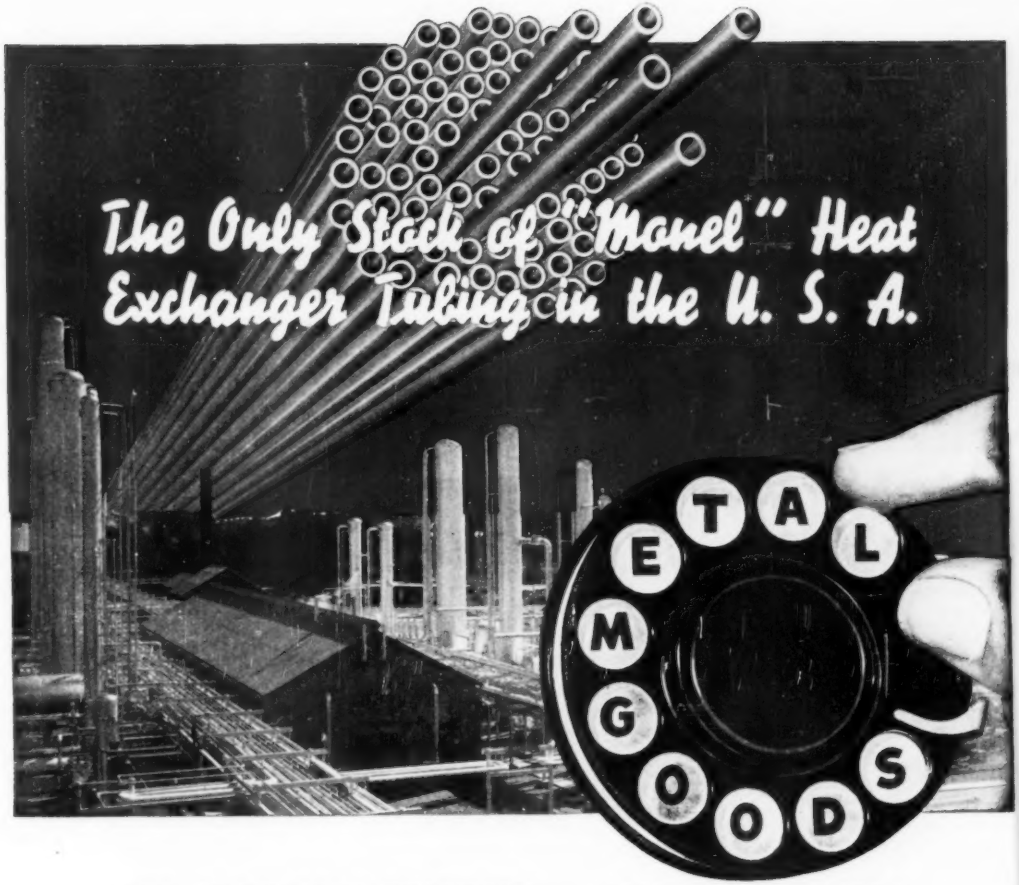
May we show you what DRYing will do for you? Write Pittsburgh Lectrodryer Corporation, 325 32nd Street, Pittsburgh 30, Penna.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In Australia: Birlec, Limited, 51 Parramatta Road, Glebe, Sidney.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

REGISTERED TRADEMARK U.S. PAT. OFF.



FOR IMMEDIATE SHIPMENT — CALL METAL GOODS

Now you can put corrosion-resistant Monel* Heat Exchanger Tubing to work for you — without delay! A stock of ¾" OD x 0.065" (16 BWG) and 0.083" (14 BWG) wall x 16' long Monel* Tubing is on hand for fast delivery from our Houston warehouse.

Where high corrosion resistance plus strength and toughness are needed . . . count on Monel* for *all* these advantages:

- **Readily fabricated, and expanded into Tube Sheets.**
- **High resistance to hydrogen sulfide, hydrochloric acid, sulfuric acid and brine. Withstands hydrofluoric acid in HF alkylation.**
- **Resists effects of cavitation and impingement.**
- **Stands up in caustic soda reboilers and in condensers for chlorinated solvents and furfural.**

For shipment TODAY . . . phone, wire or write your nearest Metal Goods warehouse.

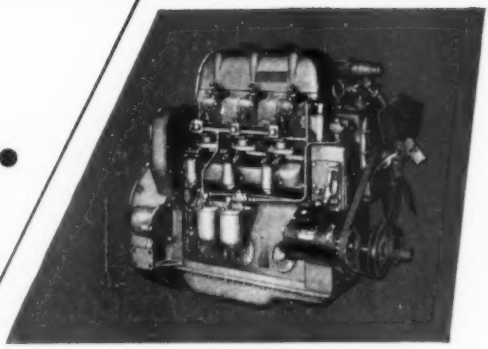
*Reg U S Pat Off

METAL GOODS CORPORATION

OFFICES AND WAREHOUSES: St. Louis, 5250 Brown Ave. • Houston, 711 Milby St. • Tulsa, 302 N. Boston
New Orleans, 432 Julia St. • Dallas, 6211 Cedar Springs Rd. • Denver, 817 17th St. • Kansas City, 1300 Burlington

Proved...

for your tough jobs!

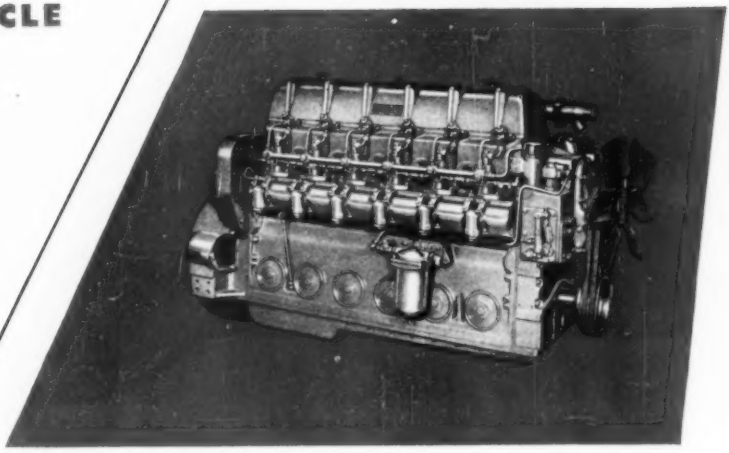


Model 387-C 3 cylinder

P&H DIESELS

2 CYCLE

Model 687-C 6 cylinder



Built for the toughest job known

Now — the new P&H Diesels are ready — after years of intensive research, development and testing in the most grueling of diesel applications — excavator service.

The new P&H Diesels introduce a number of advancements in design — in performance — and in easier servicing — which will be welcomed in many fields of diesel usage, mobile, stationary and marine.

Literature is now available. Address Harnischfeger Corporation, Diesel Division, Port Washington, Wisconsin.

P&H DIESEL DIVISION HARNISCHFEGER CORPORATION

EXCAVATORS · ELECTRIC CRANES · ARC WELDERS · HOISTS · WELDING ELECTRODES · MOTORS

Where have you seen THIS face before?

New fact-filled catalog will be sent to anyone requesting it on company letterhead.

It's the honest face of a good instrument—a familiar face because it has been widely chosen by oil men who know that the success of their equipment rests in no small part on the accuracy of its pressure indication.

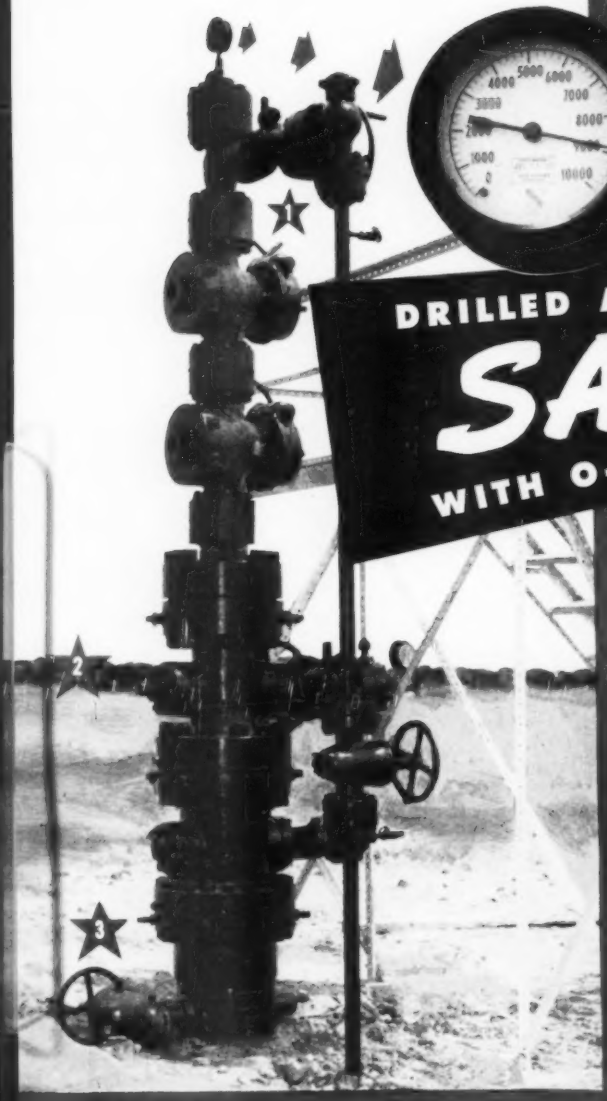
Often that face is the face of a veteran—a Marsh Gauge that has seen many years of tough going. But, as you trace back over the Marsh Gauges you have known, can you recall a single one of them that has ever failed to do its job right?

To build such a gauge requires more than good design and construction. It requires a fund of practical knowledge that can be acquired only in the vast proving ground of the oil country—the kind of knowledge that Jas. P. Marsh Corporation has been accumulating for more than 80 years.

JAS. P. MARSH CORPORATION, Dept. L, Skokie, Illinois

THE MARSH BRANCH *plant at Houston offers shipment from stock and facilities for repairing all makes of gauges.*

MARSH GAUGES



CONTINENTAL'S ESTES NO. 1

...WORLD'S HIGHEST PRESSURE WELL

DRILLED AND COMPLETED SAFELY WITH O-C-T EQUIPMENT

1 O-C-T PC CHOKE

Bean replacement has been greatly simplified in this new model O-C-T PC choke. By simply removing the bonnet-type flow stop, the bean replacement can be accomplished in a fractional part of the time required by conventional methods.

2 O-C-T TUBING HEAD

The T-16 OU tubing head, a tube-opening type with a two part set packing seals between the tubing and casing heads, has one "O" ring and one special "U" ring located in the lower flange to seal around the casing. Both types of seal are fully supported against extrusion by the O-C-T plastic "non-extrusion" ring. This pressure ring provides a means of restricting the pressure to the casing areas which save flange bending and protects ring gaskets and casing hangers from corrosive fluids.

3 O-C-T "C-19" CASING HEAD

The only casing head designed to meet every well completion condition in a single compact model, the O-C-T "C-19" casing head has further distinguished itself by providing increased rig safety and decreased installation time. It eliminates open bolt handwork. It is simple and easy to set from the derrick floor.

Twice this year, Oil Center Tool Company equipment has been used on world record wells . . . on the world's deepest well in Wyoming and now on the world's highest pressure well in Louisiana.

On Continental Oil Company's Estes No. 1, located near Welsh, La., the pressure gauge stood at 8,920 pounds tubing pressure. Bottom hole pressure is ± 11,000 psi. The well is 11,476' deep. The production sand is from 11,263'-11,269'.

With the O-C-T "C-19" casing head as the foundation, the wellhead assembly on this world's highest pressure well consists of the C-19 casing head and the O-C-T T-16 OU tubing head, "topped off" by the new O-C-T PC production choke.

On your next well . . . on wells of any depth or pressure . . . take advantage of the added strength, safety, convenience and flexibility provided by dependable Oil Center Tool Company equipment. As a result of progressive engineering and precision manufacturing practices, O-C-T now produces a line of "precisioneered" products which have materially increased the margin of safety in drilling, completing and producing deep, high pressure gas and oil wells.

O-C-T CONGRATULATES THE MEN WHOSE SKILL AND COURAGE WERE RESPONSIBLE FOR SAFELY DRILLING AND COMPLETING THIS WORLD'S HIGHEST PRESSURE WELL.

Oil Center Tool Co.

P. O. Box 3091, Houston, Texas

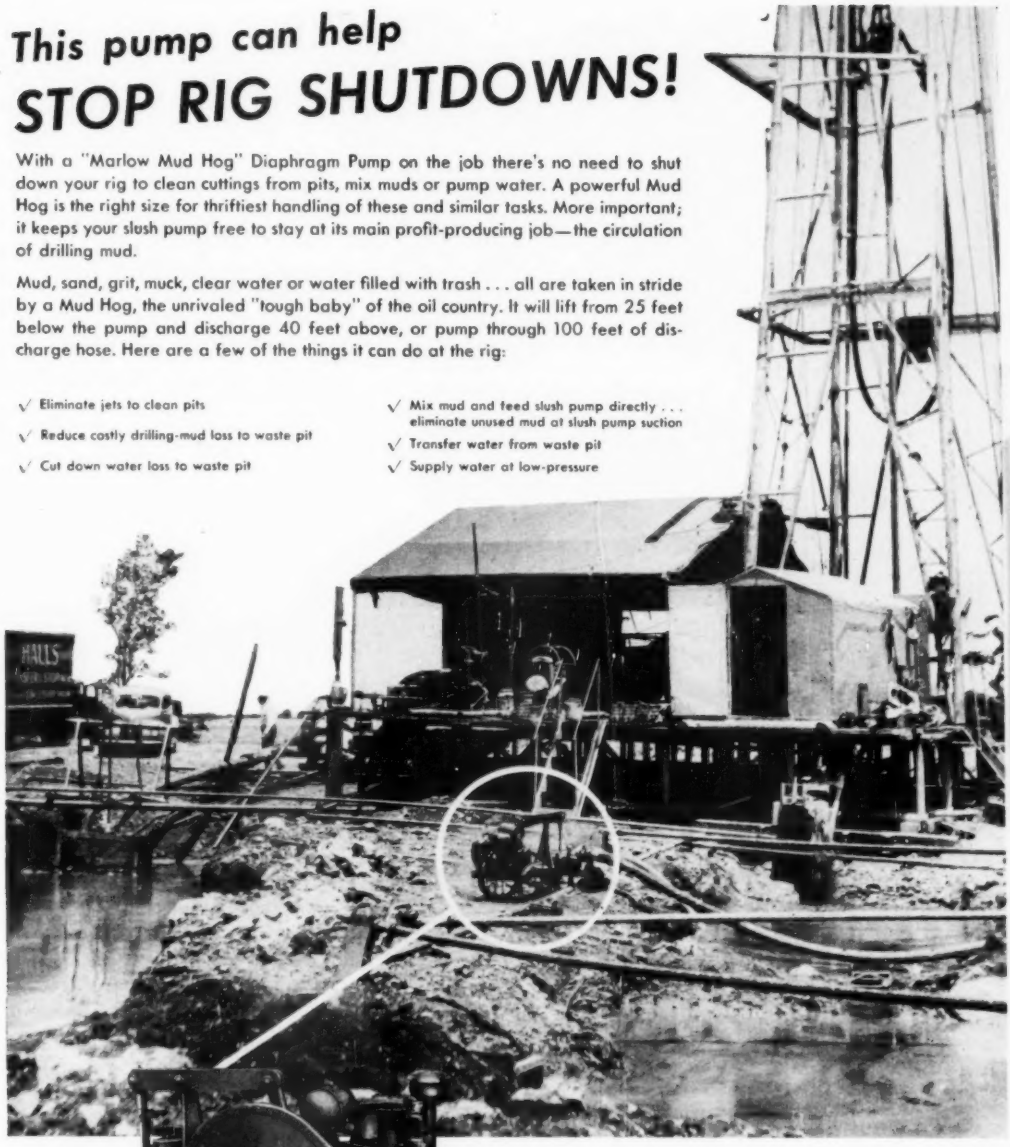
Export Representatives: Venezuela, Colombia, Peru, and Ecuador—Berry & Hall, Apartado No. 304, Maracaibo, Venezuela. Sterling Areas—Le Grand, Sutcliff & Gell, Ltd., Southall, Middlesex, England. Address Export Inquiries for All Other Countries to P. O. Box 3091, Houston 1, Texas.

This pump can help
STOP RIG SHUTDOWNS!

With a "Marlow Mud Hog" Diaphragm Pump on the job there's no need to shut down your rig to clean cuttings from pits, mix muds or pump water. A powerful Mud Hog is the right size for thriftiest handling of these and similar tasks. More important; it keeps your slush pump free to stay at its main profit-producing job—the circulation of drilling mud.

Mud, sand, grit, muck, clear water or water filled with trash . . . all are taken in stride by a Mud Hog, the unrivaled "tough baby" of the oil country. It will lift from 25 feet below the pump and discharge 40 feet above, or pump through 100 feet of discharge hose. Here are a few of the things it can do at the rig:

- √ Eliminate jets to clean pits
- √ Reduce costly drilling-mud loss to waste pit
- √ Cut down water loss to waste pit
- √ Mix mud and feed slush pump directly . . . eliminate unused mud at slush pump suction
- √ Transfer water from waste pit
- √ Supply water at low-pressure

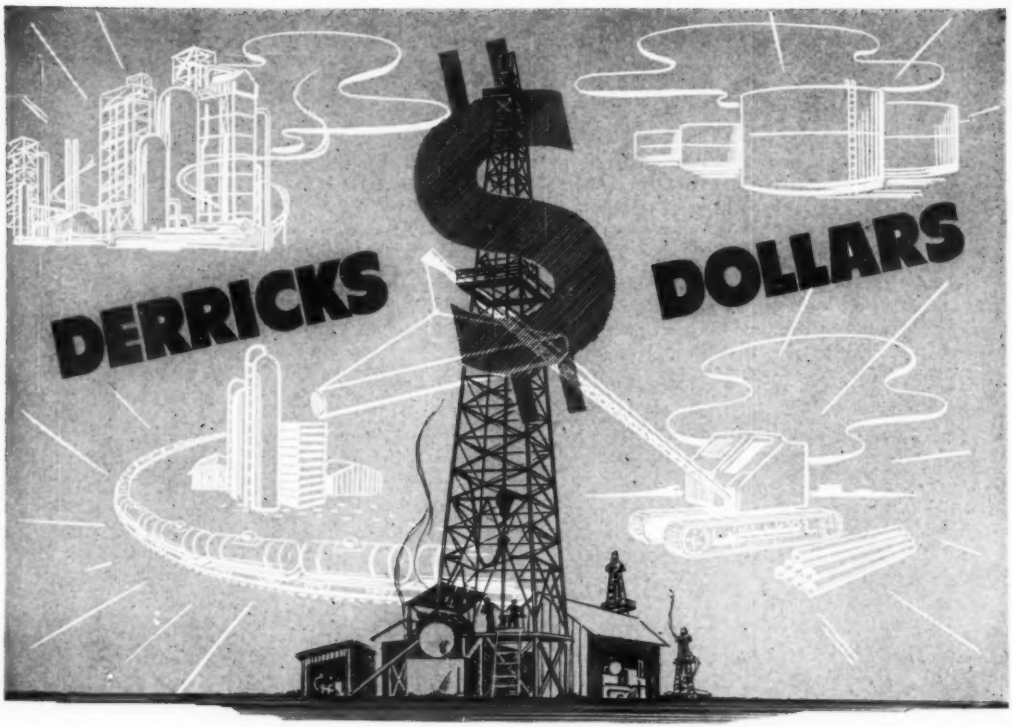


MARLOW MUD HOG
DIAPHRAGM PUMP

Features of this ruggedly constructed pump include patented ball valves, self-cleaning pump bodies, long-life diaphragms and a steel plate walking beam that has never been known to break. Sizes 3- and 4-inch single and 4-inch double, 3000, 6000 and 9000 GPH. Skid base or steel or pneumatic wheels. Gasoline engine or electric motor driven. Write for full details. Midwestern office: 226 East 4th Street, Tulsa 3, Oklahoma. Phone 5-5668.

MARLOW PUMPS • RIDGEWOOD, N. J.

Manufacturers of Quality Pumps Since 1924



...and the *Drilling Contractor*

If ever there has been an industry whose growth is sparked by individual efforts, it is the giant Petroleum Industry, now in its 90th year. Throughout its long and colorful history, the Drilling Contractor has been the Industry's most aggressive individual. Perseverance, determination and unswerving confidence in their own belief, has led to the discovery of many of our greatest oil fields by Drilling Contractors.

Many of the millions of dollars required by the Petroleum Industry for the production and development of its products have come from Texas Banks. The City National Bank of Houston, located in this great oil center of the Nation, is broadly experienced in oil and gas financing. The Oil and Gas Department's experience with the industry and knowledge of its financial requirements assures a comprehensive understanding of your problem which leads to prompt attention.

The CITY NATIONAL BANK OF HOUSTON

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

They Say—

Safety

Sir:

We would appreciate very much having your permission to reproduce Ralph L. Boyer's article "Proper Safety Measures Help Avoid Crankcase Explosions" which appeared on page 165 of the August 18 issue of The Oil and Gas Journal.

Because of the merit of the article and its pertinence to certain operations of the Products Pipe Line Department, we desire to circulate the information to our field supervisors and employes by means of a ditto bulletin.

Charles E. Cummings,
Editor, Philnews,
Phillips Petroleum Co.,
Bartlesville.

Editor's note: To Mr. Cummings and others who have made the same request, permission granted.

Horticulture

"Bless my soul, Cynthia—I've always thought of that plant as the common dandelion." *From NAFT Magazine, Anglo-Iranian Oil Co., Ltd.*

Oil in Canada

Few people realize that the first producing oil well on the North American continent was opened in Lambton County, Ontario, in 1858, the

Specify NAYLOR PIPE on Applications like These

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Sizes from 4" to 30" in diameter —thicknesses from 14 to 8 gauge.

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It will pay you to take advantage of the plus performance made possible by the exclusive Lockseam Spiralweld structure of Naylor light-weight pipe.

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CONCERNED ABOUT LOSSES RESULTING FROM VOLUME SHRINKAGE AT LOW OIL DELIVERY TEMPERATURES? ...THEN INSTALL

Paracoil

TANK SUCTION HEATERS

TO SOLVE YOUR PROBLEMS

TANK SUCTION HEATER INSTALLATION

The shell is open at the inside end. The oil moves across the heating tubes as it passes through the shell to the suction connection outside the tank.

In Bulk Oil Terminals and Refineries the world over Paracoil Tank Suction Oil Heaters are licking the problem of economically preheating heavy viscous oils to permit their withdrawal from storage tanks. They are also preheating the lighter grades of fuel oils to their proper delivery temperatures to avoid the costly volume losses incurred when such oils are sold at low temperatures.

WITH PARACOIL TANK SUCTION OIL HEATERS

- **You Heat Only The Oil That Is Being Withdrawn From The Tank.** (Thus radiation losses resulting from heating entire tank contents are eliminated.)
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- **Heater Tube Bundle Can Be Withdrawn For Inspection And Cleaning.** Breaking of oil suction line not necessary.
- **All Piping Connections And Gaskets Are Outside The Tank.**
- **U-Tube Design Permits Free Expansion And Contraction Of Tube Bundle.** Either high or low pressure steam can be used as the heating medium.

Prompt Shipments!
Our extensive stocks of tubing and pipe enable us to make quick deliveries to meet your immediate requirements.
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SPEED UP DELIVERIES AND CUT OIL VOLUME LOSSES WITH PARACOIL TANK SUCTION HEATERS

In addition to the Paracoil Tank Suction Heaters, we also design and fabricate Line Type Discharge Heaters of any capacity. Illustrated is a Paracoil Straight Tube Type Fuel Oil Heater for bulk station service—capacity 2,000 gallons per minute, No. 6 oil, 100°F to 160°F, steam at 15 psig. Weight 12 tons.

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year before the Drake well in Pennsylvania . . . .

The prospect of a sharp reduction and possibly in time of a cessation of net imports of oil has in itself important implications for Canada's balance of payments position. Last year aggregate oil imports cost $300,000,000, which had to be disbursed almost entirely in U. S. dollars since the United States and Venezuela supplied the major part. The prospect of reducing U. S. dollar expenditures substantially makes Alberta oil one of the most important and encouraging recent developments in Canada's economic life. *Monthly Review, The Bank of Nova Scotia.*

Economy

Sir:

I appreciate very much your kind letter of August 30th endorsing our efforts to eliminate unnecessary spending in this Department.

Your kindness in writing and your support are very encouraging.

Louis Johnson,
The Secretary of Defense,
Washington, D. C.

South America's Biggest

Cardon, Venezuela, is a newly born city—one which literally sprang out of the desert in no time at all. Four years ago it was nothing more than cactus plants and dust clouds. Today, it boasts 12,000 busy citizens and the largest industry of its kind on the continent.

The industry is the Shell refinery, largest petroleum installation in South America. *The Shell Roar, Shell Oil Co.*

Exports

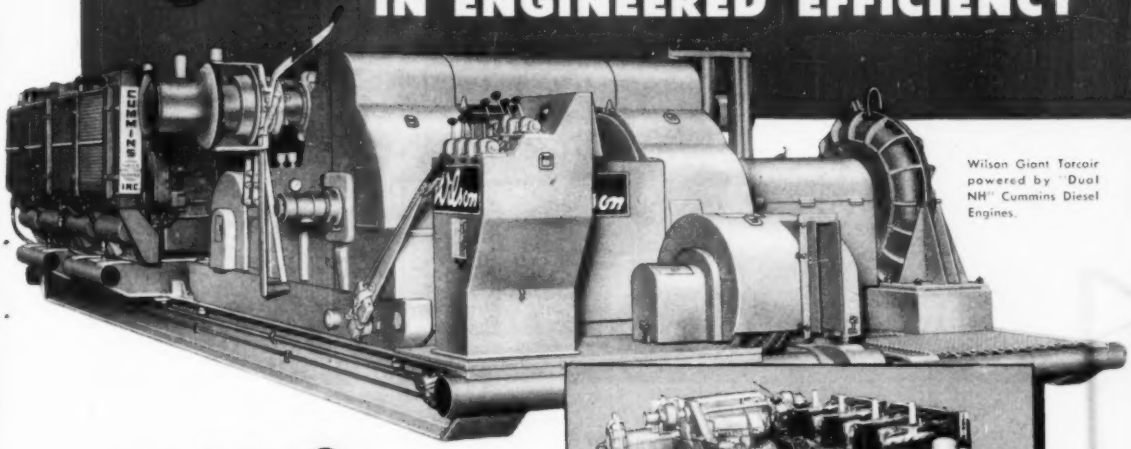
Last year the United States sold abroad, or exported, goods and services amounting to $12.6 billion, while we imported something over $7 billion. During the first half of 1949 we exported to the value of $6.6 billion, while imports were $3.4 billion. The trend seems to be toward increased exports and diminishing imports. In view of the fact that at present many of those to whom we export cannot afford to pay for the goods, either in gold or in other goods, it is obvious that such a condition cannot permanently endure. *Pure Oil News, Pure Oil Co.*

What It Takes

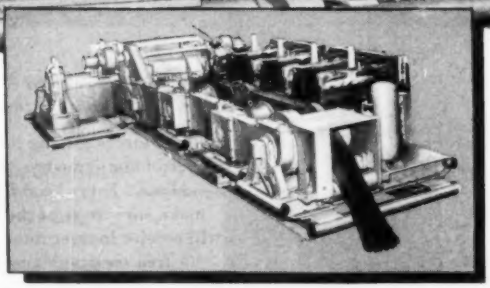
To fill the tanks of the B-36, the pride of the U. S. Air Force and the world's largest land-based bomber, 21,116 gal. of gasoline and 1,200 gal. of oil are required. This is more than enough gasoline to fill two average railway tank cars, or so drive a popular-make automobile, averaging 15

Years ahead

IN ENGINEERED EFFICIENCY



Wilson Giant Torcair powered by "Dual NH" Cummins Diesel Engines.



Wilson

SENSATIONAL NEW GIANT Torcair DRILLING RIGS

CHECK THESE ADVANCED FEATURES:

- Torque Converter Drives on 1, 2 or 3 Engines.
- Wilson Air-Tube Disc Drum Clutches.
- Full Vision Panel Air Control.
- Entire Rig is transportable in 1 load.
- Meets most road clearance requirements.
- Full Circulating Water-Cooled Brakes.
- Single Drum or Double (low type) Drum.
- Reverse speed automatically engaged.
- Single or Multiple Engine Drive.
- Full 42" Width Drum.

RATED CAPACITY:

8000 Ft. with 4½" drill pipe
9500 Ft. with 3½" drill pipe

WILSON Giant Torcair Rigs powered by Cummins "Dual NH" Diesel Engines provide sensational flexibility . . . money-saving efficiency . . . "cushioned power!" Both years ahead in engineered efficiency! The NEW WILSON GIANT TORCAIR RIG is engineered with the well known WILSON pioneering know-how . . . for example, note the position of the PANEL AIR CONTROL in the above illustration . . . it's placed to give the driller FULL VISION of the whole operation . . . working the controls is practically effortless, releasing the driller for almost full time on other duties connected with making faster, safer holes. Get the facts before you sign up for any rig. Write for WILSON BULLETIN No. 172.

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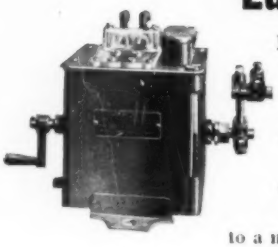
Lubricators



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In pipe line, oil tank and bottom hole treatment, the various chemical compounds are automatically introduced in accurately measured quantities by Manzel Chemical Feeders. Sturdily built and simply designed, these feeders have an unsurpassed record for dependable, trouble-free operation.

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miles to the gallon, almost 13 times around the world. *Connecting Rod, Stanolind Pipe Line Co.*

Big Operations

Over 40 different types of finished products are loaded into ships, including such items as four grades of aviation gasoline, 10 different motor gasolines, two kinds of tractor fuel, and so on through the list of diesel oil, gas oil, lube distillate, naphthenic acid, heavy diesel oil, residual fuel oil, and cut-back asphalt.

Every day 266,000,000 gal. of sea water are used for refinery cooling and other purposes—more water than a big city uses. Every day a million and a half gallons of fresh water are used—most of it brought by ship from the United States. Lago is more electrified than any other large refinery. There are 4,300 electric motors, of all sizes up to 1,250 hp. The installed power capacity in two powerhouses is 52,500,000 kw., enough to light an average city of 100,000 people. *From statement regarding Aruba, D.W.I. refinery of Lago Oil & Transport Co., Ltd., with a crude oil capacity of 400,000 bbl. daily.*

Railroad Rumbles

Folks living along the Rock Island Railroad got used to the huff and puff of steam locomotives. Since the road put 10 new diesels on its Chicago commuter lines 4 weeks ago, it's heard kicks about the "new noises." One woman phoned this gripe: "The sound when the diesels start up wakes my baby." Others cuss the horns.

Diesel makers, who've heard these complaints before, say folks will get used to the oil-burners' sounds in 6 months or so. *Wall Street Journal.*

Free Scholarships

The opportunity of attending college has been extended to 43 Cities Service sons and daughters by the Henry L. Doherty Educational Foundation, which has granted them a scholarship to the college of their choice. Of the 43 winners, 15 are sons and daughters of Cities Service Oil Co. (Del.) employes. . . .

In addition to the newly named winners, renewals were authorized for 46 students, making a total of 89 students in college through Foundation help, in comparison to 71 as of last year. The granting of a greater number of scholarships was made possible by increased participation of Cities Service Oil Co.'s employes in the amount of $2,460.59, which is the largest since the Foundation's institution in 1939. Allocation of returns from Foundation investments and the company's contribution of an amount equal to that of the employes complete the fund. *Empire, Cities Service Oil Co. (Del.).*

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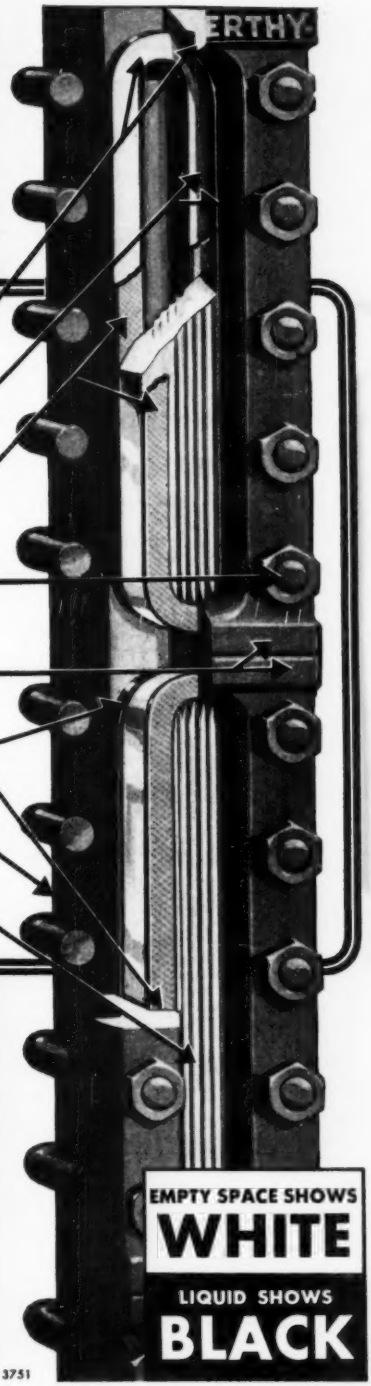
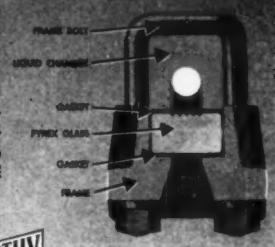
Drop Forged Steel



1. **PROTECTED GLASS.** Frame completely contains glass—no part exposed. Glass supports none of frame weight.
2. **UNIFORM GASKET PRESSURE** assured by precision finishing of retaining surfaces.
3. **EQUAL RESILIENCE ON BOTH SIDES OF GLASS** due to interchangeable gaskets which also prevent improper reassembly in the field.
4. **PERFECT GASKET JOINTS WITH MINIMUM BOLT TENSION** because misalignment of parts is impossible. This also eliminates frequent cause of glass breakage.
5. **DISTORTION PREVENTED** by reinforcing beam and scientific distribution of metal in frame. (Distortion is a serious cause of glass breakage.)
6. **GASKET BLOW-OUTS PREVENTED** by full metal backing of surface and periphery of both gaskets.
7. **RIGIDITY AND PERFECT ALIGNMENT** assured because liquid chamber is machined from solid block of temperature resistant steel heat treated to prevent warping.
8. **PYREX GLASS** is used exclusively because it has proved far superior in resistance to thermal shock and erosion.

Penberthy Reflex Gages make reading of liquid level easy and unmistakable; empty space always shows white—liquid always shows black. They are made in any length desired and from various materials to successfully withstand corrosion, contamination and high temperature conditions. Conform with API—ASME standards.



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3751

easy to take this Roller Chain apart.. or Assemble it!

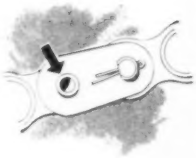
The revolutionary new Baldwin-Rex "BA" Riveted Oil Field Roller Chain makes field assembly and disassembly amazingly easy. With its unique new single pin connector, you get the superior performance and longer life of riveted roller chain and even easier assembly and disassembly than with detachable roller chain.

HERE'S HOW SIMPLE IT IS

Locate the single pin connector link by its distinctive "tear-drop" shape. One pin in this link has a cotter on one end; the other end is spun over a washer. The other pin is fully riveted to assure the superior life of riveted chains.

Remove the cotter and drive out the pin. Pin is a slip fit through the chain except for a milled flat on the cottered end which is press-fitted into a special hole in the connector plate. There is no danger of destroying fits or damaging chain parts.

The washer spun over one end of the pin and the press fit of the milled flat in the special hole in the connector plate in the other end plus the cotter hold the single pin connector pin snugly in place for most effective operation and long life.



An important advantage to you is the fact that the other pin of the single pin connector link remains firmly riveted in place. It holds the chain parts together, preventing plates from falling out when chain is taken apart or assembled.

Your local supply store will be happy to give you all the facts, or if you prefer, write for your copy of the New Baldwin-Rex Oil Field Bulletin

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ROLLER CHAINS

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JOURNALLY Speaking

Meal for Drillers

ALL year 'round our engineering writers scramble up derricks and peer down rat holes to be the "fustest with the mostest" on what's new in drilling practices. But they save up their most unusual yarns for this issue to make a special meal for the annual convention of the drilling contractors.

As the piece de resistance this year the menu offers a 35-page "Drilling Handbook," complete with pictures and diagrams and indexed from Unitized Rigs to Auxiliaries. If you never drilled a well before, this probably won't help you much, but if you're a driller it ought to be a very useful thing to keep in the doghouse. Our editors don't claim there is anything very startling in this handbook, but they say it's a neatly condensed review of modern equipment and practices.

The startling tidbits they are serving as side dishes and dessert—such as the speed record set by a drill that uses mud instead of a kelly to turn the bit, the report on drilling for heat, the wire recording on a rig floor, and the tone poem on winter in the Rockies.

Stacked Statistics

OIL men who draw ominous conclusions from reports of the number of drilling rigs stacked may take heart from the statistical analysis that John Casper, our statistical analyzer, presents on page 179 of this issue, which shows that more footage is being drilled with fewer rigs.

Of course this is small comfort to the contractor whose rigs are stacked, but it does suggest that figures on idle rigs do not necessarily constitute a reliable index of the activity of the entire oil industry.

Unitized Dividends

OLD-TIME editors would turn over in their graves if they could see the story and picture on page 163 of this issue in which our Gulf Coast editor hits a new high in lazy-man's reporting.

There he stands brazenly, arms folded, while a machine does all his note taking for him. When he gets back to the office all he has to do is tell the girl to type out the Q & A and mail it in, and if there are any calls for him he'll be on the golf course.

Talk about a unitized rig paying dividends! Mac would appear to have reached the ultimate in unitized reporting.

Model Medicine

FOR several years now the legal committee of the Interstate Oil Compact Commission has been drafting what is billed as a model state statute for oil and gas conservation. It was supposed to be ready for submission to state legislatures before this, but in making his report the committee chairman, Maj. Gen. Ernest O. Thompson of Texas, explained:

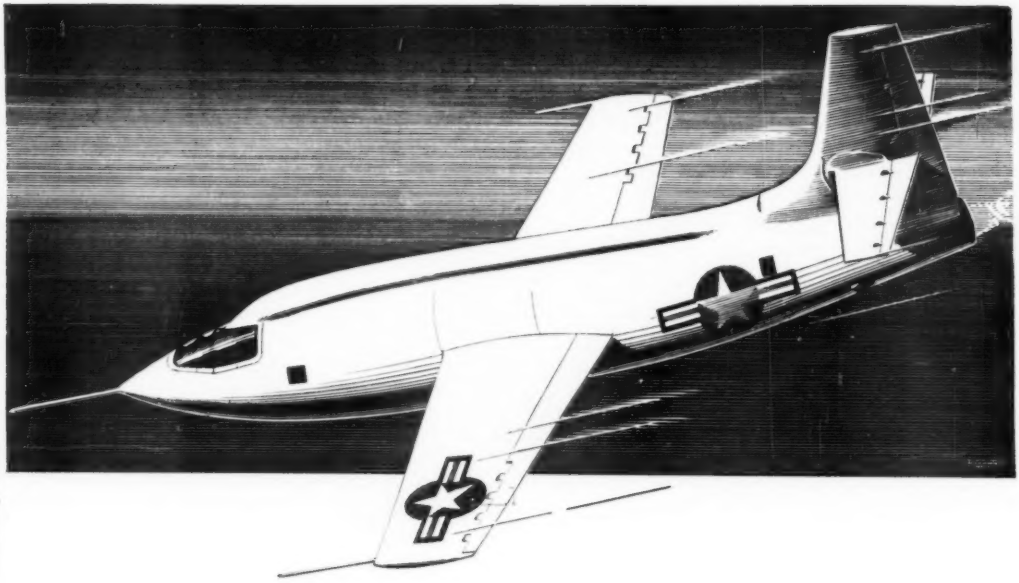
"We had 27 lawyers in one room all day, so you can imagine the amount of argument we had. In spite of this, believe it or not, we managed to reach agreement on all principal points."

The only thing left, he said, is to "put in the commas," which should not take more than another 3 months. At the December meeting of the Compact, he promised, the committee will have a completed draft with many alternate provisions "so that a state can take its choice between a mild laxative or a strong purgative."

Awful Parody

Whoever in the editorial department wrote that head on page 200 is going to get in trouble with the Society for the Preservation and Encouragement of Barber Shop Quartet Singing in America, Inc. That good old male quartet number is "Springtime in the Rockies," not winter, and perusal of the article suggests that winter operations up there are not likely to cause a driller to burst into song.

—*Henry D. Ralph*



Penetrating farther and faster . . . with Jet

Modern engineering and precision workmanship produced this jet fighter after years of research and development. Flown by highly skilled, carefully trained men, it penetrates new horizons of speed and altitude.

The Welex Jet methods of casing perforating and Torpedo Jet blasting likewise reflect modern engineering and precision workmanship.

Time, money and experience were invested unstintingly in the development of this modern process by Welex, Byron Jackson Co. and E. I. Du Pont de Nemours & Co. The most exacting technical work was involved, but one by one the technical problems were mastered and improvements made until the present-day Welex Jet Process became a practical reality. Today, the Welex Jet Process is finding world-wide application in oil well casing perforating and open hole shooting. It gives you up to 300% greater penetration than any other practical method ever known, plus precision and safety never before attainable. Welex Jet Services offers you the benefit of experienced field crews carefully trained and supervised by the men who originated the Jet Process.

Phone the nearest Welex station for prompt service day or night. *Write for illustrated bulletin on Jet Processes.*

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The OIL AND GAS JOURNAL

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Stop Trouble before it starts...

Baker "BAKWIK" Drill Pipe Float Valve Assemblies are "standard equipment" with a large majority of drilling contractors and the drilling departments of oil companies. They *know* that the inexpensive BAKWIK Drill Pipe Float Valve is saving money for them *during all drilling operations* and is *low-cost insurance against serious accidents.*

BAKWIK SAVES MONEY FOR YOU because it—PREVENTS PLUGGING THE BIT with the danger, lost time, and the annoyance of pulling wet strings—RELIEVES WEIGHT ON DERRICK and other rig equipment because it "floats" the drilling string—LENGTHENS LIFE OF WIRE LINES AND BRAKE BANDS due to the reduced weight of the drilling string, which is "floated" in—DOES NOT INTERFERE WITH DRILLING because the valve can be quickly lifted out of the string and just as easily replaced. And BAKWIK is an "Ace in the Hole" to MINIMIZE OR PREVENT SERIOUS DAMAGE in event the drilling string should part while running-in or coming-out of the hole.

NO TROUBLE TO INSTALL OR REMOVE—Many operators install the Baker BAKWIK Drill Pipe Float Valve Assembly in a valve chamber in the drill collar, where it is held in place by the pin on the drilling bit—see illustration. Or it can be positioned in a Baker Model "B" Drill Pipe Float, Product No. 480, at any point in the drilling string, held in place by the tool joint pin.

The strong, simple valve assembly is made entirely without threads and is merely dropped into place by hand. No tools or wrenches are required to install or remove. When an unrestricted passageway is desired, the valve assembly is lifted out, and surveying instruments, or other devices can be run through the drill pipe.

SERVICED ON THE DERRICK FLOOR—The inexpensive wearing parts are available at your supply store, and are quickly and easily installed on the rig. The four illustrations show how simple it is to replace the valve seal.—You'll wonder how BAKWIK can *do* so much, *save* so much, and *cost so little*—so *order one today* from your supply store.

BAKER OIL TOOLS, INC.

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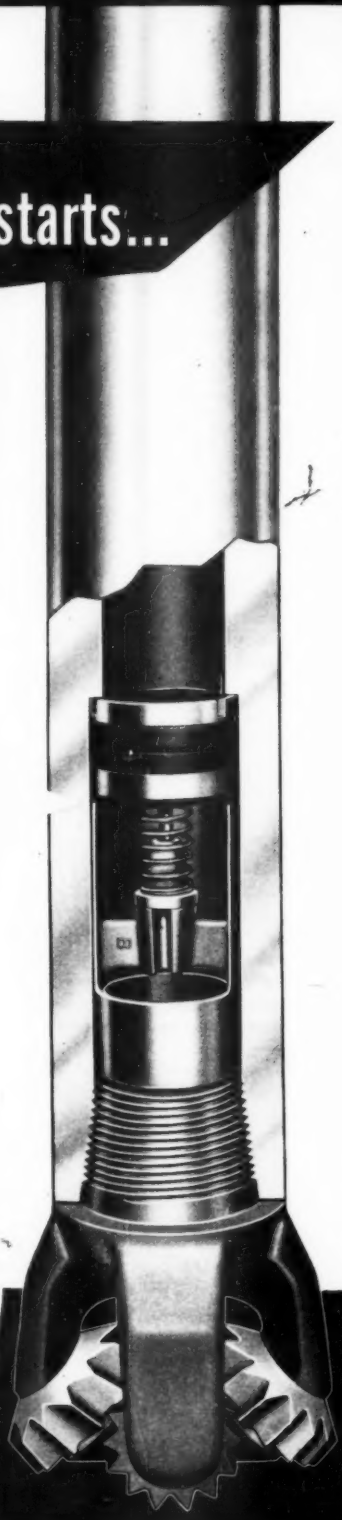

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THE OIL AND GAS JOURNAL

Competition of Quality

MEMBERS of the National Petroleum Association at their annual meeting last week were told that manufacturers of lubricating oils selling in both international and domestic markets are faced with an oversupply of products for an indefinite period.

While the membership and scope of activities of this oldest of the oil-trade associations have widened in recent years, its major concern—as it was when the organization was founded—is the position of the refiner who manufactures quality lubricants from the Pennsylvania Grade crude oils. It attests to the hardiness of this group of operators that they have successfully withstood the many changes in the oil business.

Eastern refiners and others met the oversupply development head-on last year. The tight markets brought about by the increased needs of the war and the immediate postwar period ended as demands leveled off and refiners were able to add to their processing facilities.

As pointed out in the N.P.A. analysis, an important recent trend has been the expansion in facilities for manufacturing lubricants at refineries outside the United States. From the beginnings of the oil business consumers everywhere looked to this country for the bulk of their lubricating-oils requirements. This was a reflection of the dominance of the United States in the oil business, coupled with the fact that most foreign crude oils were not suitable for the production of lubricants.

Conditions have changed. Some of the newer foreign crudes give satisfactory yields of lubricants. Furthermore, processing methods have greatly increased the types of crude oils from which satisfactory lubricants can be obtained. There is the additional fact that several governments, in the furtherance of their nationalistic policies, are stressing the desirability of their countries being self-sufficient in the matter of lubricating oils.

While it is not anticipated that other countries considered as a unit will be self-sufficient in the matter of supplies in the near future, their expansion in processing facilities will mean that the percentage share of domestic refiners in foreign lubricating-oil markets will be substantially less than it was prewar. There will also be competition from companies which have output in excess of the requirements of their own countries.

Thus measured solely in barrels it would appear that lubricating-oil markets would be dominated by excess supplies for some time to come. Fortunately there is the matter of comparative quality. Solvent refining and other developments in processing have established new standards in specifications and operating efficiency.

Operating facilities which have not kept pace with these trends are obsolete. Through the years there have often been comparable developments in other phases of refining operations. Measuring capacity on a quantity basis is one thing; capacity on the foundation of quality is something else.

Past presidents of A.A.O.D.C. are shown here as they met in Dallas. Left to right are N. H. Wheless, Wheless Drilling Co., Shreveport; A. H. Rowan, Rowan Drilling Co., Fort Worth; Howard P. Holmes, Two States Drilling Co., Fort Worth; E. C. Brown, Brown Drilling Co., Long Beach, Calif.; J. E. Warren, Carl B. King Drilling Co., Midland; William T. Payne, Big Chief Drilling Co., Oklahoma City; and Joseph S. Morris, Allen & Morris, San Antonio. J. E. Brantly, Drilling & Exploration Co., Dallas, the association's first president, was not present at the meeting

Drilling Technology Is Lagging Behind Needs, Reistle Warns

by D. H. Stormont

DALLAS.—"The technology of drilling during recent years has not kept pace with diverse and difficult drilling," C. E. Reistle, Jr., director and manager of Humble Oil & Refining Co.'s production department, told the American Association of Oilwell Drilling Contractors in the opening session of its annual meeting here Monday morning.

Attendance at the Dallas gathering, the ninth annual meeting of the association, was expected to exceed the record of 816 set at last year's Houston meeting. Registration at the end of the first day was slightly over 700 but late comers were expected to bring the total to around 850.

Technical developments during these years have resulted in more efficient utilization of equipment and manpower, Reistle said, but these advances were not sufficient to offset the rapid increase in over-all costs.

Shown at the Dallas meeting are, left to right, Frank M. Porter, Fain-Porter Drilling Co., Oklahoma City; C. F. Whaley, Chet Whaley Well Servicing Co., Houston; George F. McQueen, McQueen & Clevenger, Fort Worth; George P. Livermore, George P. Livermore, Inc., Lubbock, Tex.; and Karl L. Kellogg, K. L. Kellogg & Sons, Compton, Calif.

In his address, "Review and Outlook for the Contractor," Reistle cited the experience of one large producing company which drilled some 600 wells in 1941 and about 750 in 1948. Last year's wells cost 140 per cent more per foot than the average 1941 footage cost, he stated, accounting for the increase as follows:

"Unit costs—material, transportation, and labor—accounted for only 65 per cent of the increase. Other factors contributing to the increase in well costs were increases in the proportion of wildcat operations, greater average depth (6,600 ft. as compared with 5,500 ft.), hard-formation wells, abnormal-pressure wells, marine operations, and more difficult completions in the multi-sand reservoirs with corresponding increases in logging and completion time. These factors brought about an increase of 75 per cent in cost. It would appear that a much greater effort need be exerted by the drilling fraternity to reverse this rising trend in cost."

Pointing out that drilling contractors accounted for 82 per cent of the total footage drilled in 1948, and operate four out of every five rotary rigs in service, Reistle said that the major responsibility for carrying on the advancement in drilling techniques lies with the contractor.

Greater Efficiency Needed

This progress, he felt, could best be in the form of improvements which will provide for more efficient performance of present operations, permit development at depths now economically impractical, and which will promote drilling in areas yet unexplored.

Deeper drilling and a more intensive effort to evaluate the producing ability of the formations penetrated, he said, is causing more time to be

spent each year in coring, logging, drill-stem testing, and completing. He believes that these operations, which consume more than 20 per cent of the total drilling time for a well of average depth, offer the drilling contractor the most fertile field for reducing waiting time and the time actually consumed in performing these services. He also pointed out that increasing fixed operating cost makes it imperative that the rate of penetration be increased and the time spent drilling be decreased.

In this connection Reistle quoted a composite drilling time analysis of 550 wells drilled by contractors during 1948 from Florida to California. The survey showed the following average figures for certain significant items: depth, 6,029 ft.; total days, 43.2; feet per rotating hour, 17.6; time rotating, 38.4 per cent of total time; moving time, 10.7 per cent; round trips, 10.1 per cent; completing, 10.6 per cent; casing and cementing, 7.4 per cent; logging, 10.4 per cent; repairing rig, 3.2 per cent; conditioning mud, 2.6 per cent; fishing and sidetracking, 2.6 per cent; and waiting, 1.6 per cent. These figures, he said, show there is need for improvements in the equipment and techniques for drilling to the depths now required at a cost which will insure a fair return.

In discussing drilling operations on the Gulf Continental Shelf, he stated that of the 56 wells completed in open water since 1945, 29 were drilled with contract rotary rigs. He added, however, that these figures do not show the true picture of the contractor's participation in this work because they did not take into consideration the fact that actual drilling is a relatively small part of the enormous amount of work and expense required in carrying out an offshore program.

New Officers Named

In its meeting on Monday the nominating committee chose the following contractors to guide the association for the coming year: Warren S. Churchill, Arrow Drilling Co., Dallas, president; J. V. Dunbar, Dunbar Drilling Co., Salem, Ill., vice president at large; J. F. Postelle, head of the Odessa company bearing his name, vice president for West Texas and New Mexico; J. A. Fox, Washington, Pa., vice president for cable tools; R. J. Wolfe, president of Grey Wolf Drilling Co., Houston, vice president for Gulf Coast; R. W. Wire, president of Loffland Bros. Co., Tulsa, for a second tour as vice president for Central Mid-Continent; R. W. Marshall, Drilling & Exploration Co., Los Angeles, vice president for California; Ira Van Tuyl, V-T Drilling, Evansville, Ind., vice president for Illinois, Michigan, Indiana, and Kentucky; and vice president for well servicing, J. J.

(Continued on page 332)

Serious Oil-Industry Effects Seen in Devaluation of Pound

NEW YORK.—Devaluation of the British pound, announced officially September 18, was regarded this week by some oil-company officials as another blow against dollar oil in international markets, although the full effect of the British action was not yet determined.

Unless the British producers raise their sterling prices by the amount of the devaluation, they will be able to undersell American-produced oil in competitive world markets. Whether British prices will be advanced was the foremost question in New York early this week.

The British companies sell a substantial part of their production for dollars at a dollar price. These transactions, providing funds for equipment purchases in this country, are not affected by devaluation. In the case of sales for sterling, the cheaper pound means cheaper oil, assuming the price is not increased or is increased by less than the devaluation.

There are several factors favoring higher British oil prices to conform to the new dollar-pound ratio. One is the fact that the British are not anxious to precipitate a price war which would react against their own dollar sales. Also, the general international price structure is built up on the general level of dollar prices on the Gulf Coast.

Markets Already Lost

The world-wide dollar shortage has already caused American producers abroad to lose several important foreign markets to British companies. Aside from a possibly higher sterling oil price, devaluation presumably will result in a greater availability of sterling in many oil-consuming countries, and an even further restriction of the dollar oil market.

The devaluation of the pound from $4.03 to $2.80 also has several other significant effects insofar as the petroleum industry is concerned. The decline in United States exports to Britain will be likely accelerated and even more stringently limited to specialty products unobtainable elsewhere.

If the general level of European prices does not rise, American companies spending dollars for expansion in Europe, such as those now building refineries, will find a much better exchange rate. With devaluation, materials and equipment in England, for example, will cost considerably less in terms of dollars.

Another ramification in the situation is the fact that some American companies were caught with balances of sterling at the time of devaluation. Conversion will now be at the lower rate. However, it is known that some oil companies had anticipated the devaluation move.

American companies at present are not permitted to sell their oil for sterling under British exchange regulations. A solution to some of these problems may be worked out in the current oil conferences taking place in Washington.

The long-range impact of the new currency ratios resulting from devaluation by a score of countries—with more expected to follow suit—has not yet become entirely clear, but conceivably the British companies, if they are able to carry out their plans for expanding their production and refining, could be in a good position to sell oil to dollar markets, even including the United States.

But Britain's oil program, long under consideration, has never been agreed to by Economic Cooperation Administration, which now is expected to eye that program in the light of the new situation.

Phillips Chemical Gets Big Carbon-Black Tax Refund

AUSTIN. — District Judge Jack Roberts has ordered the state to refund $265,000 in carbon-black taxes to Phillips Chemical Co.

Phillips had protested payment of the taxes on the basis that the company process used oil instead of natural gas for the production of carbon black. The carbon-black tax applies only to the product of natural gas, the court ruled.

17 Carthage Field Gas Wells Reported Sold

SHREVEPORT.—Glassell & Glassell reportedly have sold interests in Carthage gas field of East Texas to Hunter Co., Inc., and Wheless Drilling Co., both of Shreveport, for $1,250,000 cash.

Glassell & Glassell had an interest of approximately 17.25 per cent in the Cheairs block of approximately 7,500 acres. This property was owned jointly with Stanolind Oil & Gas Co. and Continental Oil Co. with Stanolind as operator. Seventeen wells, including one now drilling, are involved.

Overproduction in California May Affect Rest of Country

by John C. Casper

OVERPRODUCTION of crude oil in California and the resulting heavy increase in stocks of crude and products in the Pacific Coast area are reaching serious proportions which may possibly have an effect on oil operations in other sections of the country.

While California conditions normally have little influence on the petroleum situation east of the Rockies, the industry was much interested in the announcement last month that 3 to 5 million barrels of heavy fuel oil would be shipped by tanker from California to the East Coast. This may be a straw in the wind, but more probably represents disposal of a distress lot which is not likely to develop into a regular movement.

However, the heavy inventory situation on the Pacific Coast should be considered in any analysis of nationwide stock figures since West Coast stocks swell the national totals yet are not generally available for meeting consumer demands elsewhere.

Conditions in California were pointed up sharply by T. S. Petersen, president of Standard Oil Co. of California, in a statement issued September 16 in response to press inquiries for his views on the current situation. Petersen said:

Implications "Critical"

"California's oil industry faces a serious problem because of the continuing overproduction of crude oil. An unbalanced condition exists between supply and demand with critical implications for the future of the industry in this state.

"As a result of overproduction, inventories in District 5, covering the Pacific Coast area, increased at the rate of 35,000 bbl. daily in the first quarter of this year, 135,000 bbl. daily in the second quarter, and 144,000 bbl. daily in July and August.

"This has resulted in an unsold accumulation of more than 24,000,000 bbl. since the first of the year, placing an unwieldly stock burden on both large and small oil companies. The problem is aggravated by surpluses of heavy fuel oils, but excess production is becoming increasingly apparent in the lighter products as well.

"The oversupply has been brought about by a variety of causes. Accelerated development to meet postwar demands created a production level of more than 900,000 bbl. daily. This year, reduced export and military requirements, decreased maritime activity, railroad dieselization, large imports of natural gas, and other factors have curtailed demand. While production cutbacks have been made in some oil fields, increases in other fields have almost counterbalanced these, so that total production for California has not declined in keeping with the demand level.

No Conservation Law

"California has no petroleum conservation law despite the fact that it is the second largest producing state in the nation. In other important producing states, such as Texas, production is controlled by law and well output has been cut back. Oil is one of our greatest natural resources and it is a matter of primary public concern to avoid wasting it. Production in excess of demand, if continued for any length of time, inevitably results in waste and higher costs. The best way to store unusable oil is to keep it underground where it will be available for its most efficient use when the need for it arises."

Petersen's observations on stocks are borne out by figures of the U. S. Bureau of Mines and American Petroleum Institute, as given in the accompanying table on West Coast stocks. This shows how stocks of crude and major products have increased during the past year, with the greatest rise in residual fuel oil.

Another table, compiled from the same sources, shows stock changes in California compared with those in the rest of the United States during the past year.

From this table it will be noted that during the past year California, which produces slightly less than one-fifth of the total United States crude production, accounted for 43 per cent of the national increase in stocks of crude and major products.

It is also apparent that 63 per cent of California's increase was in residual fuel, and 19 per cent was in crude, a large part probably heavy crude. In the rest of the United States, stocks of residual fuel oil are now lower than they were last year, but in California they are 19,000,000 bbl. higher.

WEST COAST STOCKS
(Thousands of barrels)

	Crude	Gasoline	Middle distillate	Residual
August 31, 1948	30,230	14,666	10,424	20,174
December 31, 1948	33,627	12,267	9,977	26,461
March 31, 1949	33,812	15,918	7,644	27,386
June 30, 1949	34,460	16,417	11,218	35,203
September 3, 1949	35,833	16,319	14,173	39,293

STOCK CHANGES—AUGUST 31, 1948—SEPTEMBER 3, 1949
(Thousands of barrels)

	California	Other U. S.	Total U. S.
Crude	+ 5,603	+ 27,056	+ 32,659
Gasoline	+ 1,653	+ 7,736	+ 9,389
Kerosine	— 60	+ 2,171	+ 2,111
Distillate	+ 3,809	+ 8,203	+ 12,012
Residual	+ 19,119	— 5,602	+ 13,527
Total	+ 30,124	+ 39,564	+ 69,688

Duty-Free Entry of Oil From Alberta Ruled Out

WASHINGTON. — Reports from Canada that the Dominion Government was attempting to negotiate a trade agreement with the United States which would permit the entry, duty free, of crude from the Alberta fields when the projected pipe line to Superior, Wis., is completed next year, were said in Washington this week to be without foundation.

Such an arrangement could not be made under the Reciprocal Trade Act, officials said.

That act, it was pointed out, permits the President to reduce import duties but it does not empower him to transfer items from the dutiable to the free lists.

The purpose of the proposed agreement, it was said, was to enable Canada to move some 90,000 bbl. daily of crude into the United States without payment of the import excise tax, and take in return a corresponding value in refined products, which would go into Canada duty-free. The products would originate on the East Coast and would go into eastern Canada, which is the principal consuming area.

It could not be learned whether the idea ever got any further than a suggestion, but it is understood the attention of the Canadian authorities was called to the limitations of the Reciprocal Trade Act.

Indications that the plan has been dropped are seen in steps now being taken by Imperial Oil, Ltd., to set up a subsidiary in the United States which would take the crude over as it crossed the border, some of it possibly in bond for refining and reexport in the form of products.

_____this week

INDUSTRY—Huge oil holdings of Mrs. Carrie Estelle Doheny in California sold to Nassau Associates, Inc., Dillon, Read & Co., subsidiary, for $35,000,000. . . . ¶Drilling technology not keeping pace with industry requirements, A.A.O.D.C. convention is told. . . . ¶At N.P.A. meeting Alexander Fraser warns that oil industry must take active interest in plight of automobile drivers or lose some of its prosperity. . . . Excess lubricating-oil capacity to remain a problem, N.P.A. is told. . . . ¶Overproduction of crude oil in California threatening serious implications for entire nation, California Standard president says. . . .

GOVERNMENT—British Government announces devaluation of pound. . . . American companies see increased competition between sterling and dollar oil. . . . Whether British companies will raise prices remains important question. . . . ¶Washington officials scotch reports Canada may be permitted to ship duty-free crude oil from Alberta fields into United States. . . . Reciprocal Trade Act prevents such an arrangement, they say. . . .

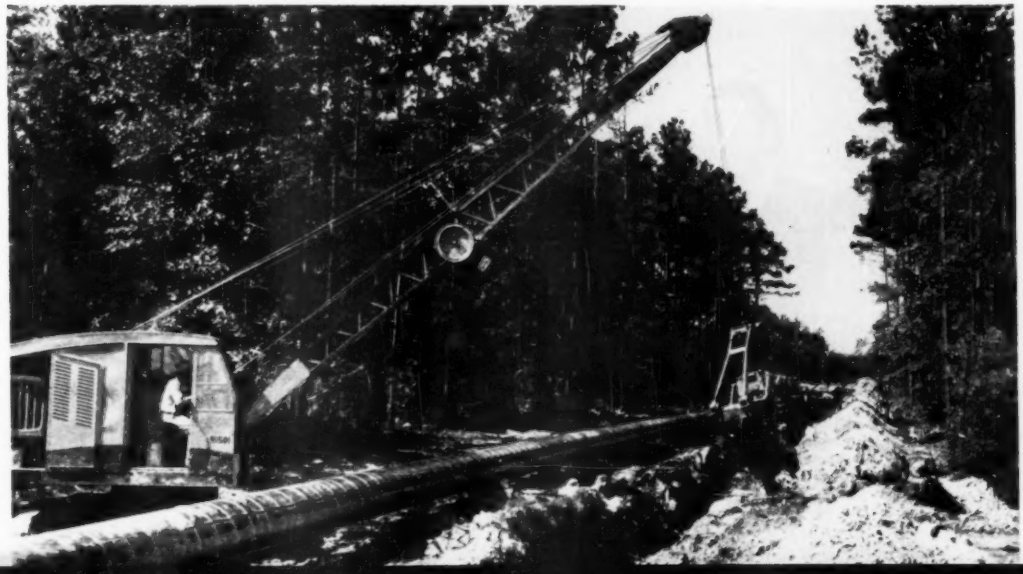
INTERNATIONAL—Chinese communists, despite imports, reported suffering serious shortage of petroleum. . . . Increased efforts to develop synthetic fuels being made. . . . ¶Foreign crude-oil production shows further drop, with world total in July showing reduction of 2 per cent. . . . ¶Gulf subsidiary reported under way on deep wildcat in Cuba's Cardenas Bay. . . . ¶Iraq Petroleum seeking right-of-way through Syria for 30-32-in. line to terminate at Banyas. . . .

TRENDS—Daily average crude production for the 5-week period ended September 17 was 4,776,000 bbl. . . . Demand for domestic crude was 4,968,000 bbl. daily in the same period. . . . To meet this demand, domestic crude stocks dropped at the rate of 192,000 bbl. daily or 6,719,000 bbl. for the 5 weeks. . . . Stocks of Texas crude declined 4,230,000 bbl. and withdrawals of Illinois-Indiana crude amounted to 1,364,000 bbl. . . . ¶Residual fuel prices increase 20 cents per barrel on East Coast. . . . Additional East Coast suppliers post increases for distillate and kerosine. . . .

REFINING—Purchase of 400 acres by Imperal Oil, Ltd., near Winnipeg for a refinery site is reported. . . . Refinery would operate on Alberta crude moved through proposed Edmonton-Great Lakes line. . . . ¶Secretary of Commerce Charles Sawyer expresses doubt as to future of synthetic rubber's future. . . . His report shows consumption this year of all rubber to be 6 per cent under 1948's consumption. . . . ¶Work begun on new catalyst change at Standard Oil Co. (Ohio) refinery at Cleveland. . . . ¶Imperial's refinery at Edmonton increases output, making it the largest plant in the country west of Sarnia. . . . ¶Universal Oil Products Co. plans new specialties-products plant in Shreveport. . . .

PIPE LINES—Pipe lines and railroads should cooperate to find solution for nation's transportation ills, J. L. Burke, Stanolind Pipe Line Co. president tells Trans-Missouri-Kansas Shippers Board. . . . ¶Work on 12-in. natural-gas line in Worland, Wyo., are a to be delayed.

An unusual pipe-line scene is this shot of a drag line operating immediately ahead of the boom tractors, seen in the background, waiting to lower the 30-in. line into the ditch. The picture was made in Mississippi on a section of the Transcontinental Gas Pipe Line Corp. Texas-New York gas line. Clearing of the ditch by the dragline of the contractor, Wunderlich & Griffis, has been necessary frequently because of sloughing caused by rains after the ditch was dug



Aid to Motorists a Must for the Oil Industry, N.P.A. Is Told

by Dahl M. Duff

ATLANTIC CITY.—An effort to rouse the interest of the petroleum industry in the plight of its best customer, the automobile owner, was made here last week by Alexander Fraser, president of Shell Union Oil Corp.

Rising costs, lack of parking facilities in urban areas, and a wholly inadequate highway system are threatening to slow down unnecessarily the growth curve of automotive transportation, he said. There is an urgent need, he added, to see that the over-all problem is tackled on the basis of long-range planning.

Fraser spoke on "The Ascending Cost of Automotive Transportation: Its Implications on the Petroleum Industry" at the forty-seventh annual meeting of the National Petroleum Association. He discussed the increasing difficulties of automobile ownership and operation and showed that the situation threatens "to decelerate the future growth and prosperity of our industry."

500 in Attendance

The 500 or more oil men at the meeting, largely representing Pennsylvania and eastern refining interests, gave their attention to a number of other industry matters during the 3-day program. Among them were product specification trends in the armed services, the public-relations program, the effect of lubricating-oil plant construction abroad on domestic production, and basing-point pricing and fair-trade standards. The association reelected all its officers, including the president, W. S. Zehrung, Pennzoil Co., Oil City, Pa.

Fraser's talk on automotive transportation attracted considerable comment. He told the N.P.A. that, for example, in New York liability and property-damage insurance now costs the average automobile owner more than $100 a year. Assuming a mileage of 7,000 a year for the area, this means the cost is about 1½ cents a mile or approximately equivalent to the per-mile cost of gasoline, he said.

"From personal experience, all of us are deeply conscious of the traffic problem which is facing the country today, but are we as fully aware of what its implications may be for our industry?" the Shell president asked. "Not alone is the problem confined to delays and annoyances engendered by traffic conditions but it is contributing in no small measure to the ascending costs of automobile transportation.

"It thus becomes a matter of serious concern if the costs of car ownership and operation are beginning to curtail the use of the vehicle itself or to price potential owners out of the market. The question presented is whether mounting costs and snarled traffic conditions are beginning to slow down unnecessarily the growth curve of automotive transportation."

Fraser pointed out the average low-priced car now costs nearly $1,600 and added the vehicle is far superior to its predecessors in reliability, comfort, and performance. Gasoline, excluding tax, costs only two-thirds what it did after the first world war, and the rubber industry now makes a tire giving the motorist four times more for his dollar than he obtained 20 years ago.

As for insurance, Fraser said this more accurately could be called the cost of accidents. Climbing rates have led entirely too many families to feel they can no longer afford automobile insurance, and he said, it is vitally necessary that the accident rate be curbed by improved law enforcement and safer driving through such measures as training in schools.

One of the most critical problems of automobile operation, Fraser continued, is parking. In Philadelphia, for example, it has been estimated that there is a 100 to 1 chance of finding parking space at the curb at the opening of business in the morning and that this diminishes to one chance in a thousand by noon. In the same city, more than 100,000 motorists compete for 20,000 spaces in parking lots and garages.

Traffic Snarls Cited

Congested traffic conditions have reached the point where fewer and fewer people are driving for sheer pleasure, Fraser said. Sunday travel near many large cities has become symbolic of annoyance, delay, and inconvenience. In addition, he added, gasoline consumption runs all the way up to 100 per cent greater on congested routes of travel compared with clear and open highway. This is the result of nearly a generation of neglect of the nation's road program.

Fraser urged the petroleum industry to give its support to a three-point program as a start toward reducing the costs of automotive transportation. This consists of support of (1) strict enforcement of traffic laws and regulations, (2) behind-the-wheel instruction to all high-school students, and (3) long-range comprehensive highway planning, combined with sound administrative practices and realistic fiscal policies.

Several members of the operating committee of the oil-industry's public-relations program reviewed various phases of the work for the N.P.A. members. Among them was Richard Rollins, Atlantic Refining Co., who revealed that Opinion Research, Inc., had recently completed another national opinion survey using practically all the same questions as were asked in 1946.

Public Is Price Conscious

The main point indicated in preliminary study of the results is the extreme sensitiveness of the public to the industry's prices. Rollins said it would perhaps be surprising to find much improvement and if the public thinks the same of the industry as it did in 1946, it means that "we are not losing ground when the things that make for ugly public temper are in the foreground."

Among those attending N.P.A. meeting: Art Clinger, manager of sales, Pennzoil Co.; L. R. Forker, general purchasing agent, Quaker State Oil Refining Corp.; William P. Gee, vice president, Texaco Development Co.; and Guy B. Hunter, Quaker State Oil Refining Corp.

"At the November meeting of the A.P.I., it should be possible to announce the results and to explain what they show regarding the work so far. . ." he said. "In the last 3 years, prices of petroleum products and profits of oil companies advanced sharply. The percentage of persons in our society who like to see prices and profits advance is small. There appears to be some definite correlation between the public's views on prices and profits and the attitude toward the industry. We are trying to work out what it is."

Much of the discussion on the public-relations program was given by Conger Reynolds, Standard Oil Co. (Indiana) who emphasized the continued threats to the industry offered by the philosophy of statism and socialism in government.

At the present time, petroleum specifications in the armed services can be issued independently by almost any branch, bureau, or command, but such action will be largely eliminated under a new system which is to go into effect March 1, 1950, Maj. E. D. Whitley, of the petroleum committee of the Munitions Board, said in another talk at the meeting. All specifications in the future will be issued from one central authority and will be similar in format, he said. Maj. Ray W. Whitson, representing the Army, outlined the service's program and said the Army is very anxious to obtain a lubricating oil and grease which will effectively lubricate its operational equipment in temperatures from plus 125° F. to minus 65° F.

For the Navy, Lt. Comdr. O. H. Landau, said this service, the same as the others, is constantly trying to reduce the number of products required. He said stiff competition for the distillate fuel fraction has made the outlook dark in this area for any future emergency and that the distillate range from which diesel fuel oil is made may have to be widened.

Of interest in the petroleum marketing field were the comments made by Robert E. Freer, former member of the Federal Trade Commission, on the subject of geographical pricing and the basing-point problem. Referring to the Standard Oil Co. (Ind.) announcement last week that it was abandoning the Group 3 pricing base, he said this apparently would make the most conspicuous oil-industry example of geographical pricing "dead as a dodo."

Freer summarized several court cases and said that under these, an identity of prices resulting from the area price-leadership such as is found in the petroleum industry "stands on comparatively safe ground in relation to the legal quicksands upon which rests its economic twin—the identity achieved through illegal collective action."

Reelected N.P.A. officers other than Zehrung are: Earle M. Craig, Freedom-Valvoline Oil Co., first vice president; A. W. Scott, Wolf's Head Oil Refining Co., Inc., second vice president; Herbert G. Eaton, recording secretary; and G. B. Hunter, Quaker State Oil Refining Co., treasurer. Four new members of the association board of trustees were chosen. They are: Clarence Thayer, Sun Oil Co.; H. B. Stone, Atlantic Refining Co.; C. L. McGuire, Roosevelt Oil Co.; and O. D. Robinson, Republic Oil Refining Co.

Principal speaker and principal officer at the N.P.A. meeting: Alexander Fraser, president of Shell Union Oil Co., left, and W. S. Zehrung, president of Pennzoil Co., who was reelected to the association presidency. Fraser, who warned of the mounting difficulties of automobile ownership and operation in a talk at the meeting, next month will become chairman of the executive committee of the reorganized Shell Oil Co.

Problem of Excess Lubricating-Oil Capacity to Stay, Keyser Tells N.P.A.

ATLANTIC CITY.—World capacity to produce lubricating oil will undoubtedly for many years exceed world demand, and the United States will continue to be the country with the greatest surplus of capacity, both for internal usage and for export.

This conclusion was presented to the annual meeting of the National Petroleum Association here last week in a paper by P. V. Keyser, Jr., manager of the lubricating department of Socony-Vacuum Oil Co., Inc. He gave country-by-country tabulations of lubricating-oil capacity and demand in 1950 and 1953 in support of his forecast.

Destruction of foreign facilities during the war and the rush to replenish inventories in the immediate postwar years caused a disproportionate demand for lubes from the United States in the 1946-48 period, he said, but the extensive programs of new construction will be virtually completed in the United States in early 1950 and in the balance of the world within the next 2 or 3 years.

The accompanying table given in Keyser's paper illustrates the over-all picture.

Discussing price and quality, Keyser said it has now been recognized that lubricating oils produced in solvent-extraction units are generally superior in quality for most applications to those produced from the same crude by conventional methods, and that it should be noted that all of the new capacity projected for 1950 and 1953, both in this country and abroad, is of the solvent type.

"It will further be seen that the ratio of solvent to total capacity in the United States will be at least 59 per cent in 1953, whereas in the balance of the world it will be 50 per cent," he said. "This factor, plus the advantages of greater technical knowledge and experience, will mean that the United States will continue to have some edge with respect to quality."

Keyser pointed out that price levels for various grades of lubes in the United States are currently depressed but said that, with continued excess capacity, it is reasonable to assume this situation will not change appreciably.

Because of the desire of the nations of the world for self-sufficiency and because of currency restrictions, even uneconomic capacity in foreign countries continues to operate at the expense of our own productive facilities. "It is there apparent," he said, "that, in spite of quality and in spite of price, the excess of capacity over demand will be brought into balance by the cutting back of refining largely within the United States."

LUBRICATING-OIL SUPPLY AND DEMAND
(Barrels per day)

United States

	Capacity	Demand	Available for export
1948	141,000	98,000	*37,000
1950	178,000	94,000	84,000
1953	180,000	102,000	78,000

Foreign, Excluding Russia and Satellites

	Capacity	Demand	Demand on U. S.
1948	26,000	65,000	37,000
1950	42,000	74,000	32,000
1953	52,000	87,000	35,000

World, Excluding Russia and Satellites

	Capacity	Demand	Excess of capacity over demand
1948	169,000	163,000	6,000
1950	220,000	168,000	52,000
1953	232,000	189,000	43,000

*Represents actual exports. In addition, 6,000 bbl. daily were added to inventories in the United States during 1948.

Texas Hikes Allowable Again, But Not Enough to Suit Many

by Leigh S. McCaslin, Jr.

AUSTIN.—Although the Texas Railroad Commission raised October crude-oil allowables by 32,044 bbl. daily last week—the second consecutive increase—the state's allowable is still 539,301 bbl. daily below the peak reached last December.

The increase was accomplished by adding one producing day to all fields. Independent operators and some purchasers indicated privately that they favored a larger increase. However, little testimony to this effect was offered before the commission at its monthly hearing here.

Joe Owen, Sun Oil Co., Beaumont, did tell Commissioners Ernest O. Thompson and Olin Curberson that even with two additional producing days his company would be short of crude. He testified that Sun is withdrawing from its stocks at the rate of 8,000 bbl. daily during September. For October, he prophesied that an additional 9,000 bbl. daily would be withdrawn because of increased refinery runs. Sun's total crude stocks were 8,918,000 bbl. on July 1, 8,857,000 bbl. on August 1, and were down to 8,850,000 bbl. on September 1. Owen characterized the present crude market as "very tight."

V. E. Smith, Petrol Refining, Inc., Texas City, and H. P. Nichols, East Texas Oil Association, Tyler, both requested two additional producing days for East Texas field. Smith said his concern has been trying for 2 years to buy 30,000 bbl. of crude daily in either Texas and Louisiana. Nichols based his plea on a 26-psi. increase since January 1 in the average bottom-hole pressure of the field.

Second Increase

The 32,044-bbl. increase in the October allowable brings the state's daily figure to 2,135,238 bbl. The commission arrested a downward trend of 8 months when it increased last month's figure 132,268 bbl. The current raise in allowables was accomplished by setting 19 producing days for the state and 17 for East Texas for the 31-day month of October. Prorated fields in the state are currently producing on an 18 and 16-day basis for a 30-day month. Estimated production of natural gasoline and distillates for October is 234,883 bbl. daily. This brings the total permissible production of liquid hydrocarbons to 2,370,121 bbl. for October.

The U. S. Bureau of Mines forecast for crude demand for the state in October is 2,190,000 bbl. daily or approximately 55,000 bbl. more than the crude allowable. Purchasers' nominations for October were 2,419,516 bbl. daily which is 53,919 bbl. higher than for the previous month.

Actual production of crude runs below the allowable figure. For the week ended September 10 production averaged 1,979,100 bbl. daily although the September allowable is 2,103,194 bbl. Hence, actual October production is estimated at around 2,030,000 bbl. daily.

Comparison Made

The October allowable, by districts, compares with the net allowable on September 10 as follows:

District—	October allowable (bbl.)	Increase over September (bbl.)
1—Southwest	31,003	200
2—Southwest	128,690	2,511
3—Gulf Coast	396,259	5,842
4—Southwest	198,387	3,073
5—East Central	36,405	501
6—Eastern Texas	87,816	400
6—East Texas field	251,768	6,563
7-B—W. Central	74,602	541
7-C—W. Central	54,164	645
8—West Texas	589,509	10,551
9—North Texas	174,719	1,213
10—Panhandle	111,916	4
Total	2,135,238	32,044

Few witnesses were heard during the 20-minute hearing other than the three mentioned earlier. A request was made by Talco Pipeline Co. that no change be made in the number of producing days for the asphaltic-base crude fields of East Texas. This was later confirmed by a commission order which kept these fields at 17 producing days, causing a slight reduction in their daily allowable. Fields affected are Como, Mitchell Creek, and Sulphur Bluff in District 5; and Alba, Coke, Coke (sub-Clarksville), Manziel (sub-Clarksville), Merigale-Paul (sub-Clarksville), Norman Paul, Talco, and Yantis, in District 6.

Paul McDermott, representing Sinclair Oil & Gas Co., Fort Worth, was the only purchaser to testify before the commission in favor of an additional producing day. Olin Culberson, as acting chairman of the commission, read into the record a report on East Texas field. The area weighted average bottom-hole pressure showed an increase of 9.24 psi. during August to 1,034.4 psi. on September 1.

The commission allowable order for October added six fields to those exempt from shutdown days. These were El Campo West, South Houston, and Turtle Bay East in District 3, and Matlock, Bonita, and Sewell Marble Falls in District 9.

The next state-wide hearing will be held at Houston, on the mezzanine floor of the Rice Hotel, at 9 a.m., October 12.

Many Petrochemistry Papers Heard by A.C.S.

MORE than 50 papers on petroleum chemistry subjects were included in the program of the American Chemical Society at its 116th national meeting held at Atlantic City this week. The society's Division of Petroleum Chemistry under which these papers were presented was in session September 19 through September 22. Authorship of 13 of the 52 papers given during the 4-day petroleum division meeting was by men identified with eight of the country's major oil companies. A number of important papers were also identified with staff members of some of the nation's leading engineering service companies.

B. H. SAGE

A new award established last year by Precision Scientific Co., Chicago, was presented to Dr. Bruce H. Sage, professor of chemical engineering, California Institute of Technology. Prof. Linus Pauling, also of Cal Tech and president of the society, made the presentation September 19. Dr. Sage's award address, "Status of Thermodynamics in the Petroleum Industry" was given at a gathering held in his honor by the society's Division of Petroleum Chemistry.

In his research Dr. Sage has studied petroleum hydrocarbons from two standpoints — thermodynamics and physical properties. His original experiments, in collaboration with Prof. William N. Lacey, were directed toward learning something about the fluids as they exist in underground petroleum reservoirs. The work progressed from investigation of simple systems to the more complex crude-oil and natural-gas mixtures.

With his associates, Dr. Sage is recognized as having provided background experimental information that has made the so-called cycling technique a routine commercial operation in oil-field production. His work has led to increased recovery of oil from underground formations and increased recovery of liquid hydrocarbons from natural-gas mixtures and also has made possible the development of better petroleum products.

WASHINGTON WATCHING

BY BERTRAM F. LINZ

Only One Policy

WASHINGTON.—Recommendations for legislation dealing with unification of federal transportation policies may be sent to Congress next session by President Truman.

The possibility that the administration will seek to do something about the major problems in water, rail, air, and highway transportation was raised by a White House directive to Secretary of Commerce Charles Sawyer to submit a report on those issues by December 1.

Commerce Department officials are conferring with representatives of the agencies having interests in transportation and the Defense Establishment and are studying the material developed by several recent congressional transportation inquiries, but while the views of others will be considered the report will be that of the Commerce Department itself and there are indications that no effort will be made to reconcile conflicting views among the other agencies.

The White House request called only for an outline of the transportation issues, but it is understood the report also will include recommendations for legislation. For the oil industry, the shipping phase of the report will probably be of most interest, since it will cover tankers, but it also has a stake in highway transportation and, of course, is a user of railroad and air facilities.

In getting into the transportation field at this time the administration may take the ball away from a Senate interstate commerce subcommittee which has been studying the subject for the past half-year and is now preparing for hearings, probably in January.

Maybe in '51

DEFEAT of the Thomas amendment providing a quota for petroleum imports was a bitter but not entirely unexpected blow to domestic oil producers, but they took some consolation from the narrow margin by which the amendment failed.

Independent-producer spokesmen in Washington were quick to declare that the fight was not over, but admitted they were not prepared to say what their next move would be.

Russell B. Brown, general counsel for the Independent Petroleum Association of America, indicated the probability that special legislation to deal with the problem would be sought next year, and the matter undoubtedly will be a major subject of consideration at the association's annual meeting next month.

Legislation, in fact, appears to be the only avenue left to the domestic industry, both the State Department and the Tariff Commission having rebuffed all appeals for help.

Whether any bill dealing with oil imports could be put through Congress next year is problematical. In the voting on the Trade Agreements Act there was considerable trading between senators, with members throwing their votes to other members' amendments in return for like favors.

An even more difficult situation would be faced in the House, where every seat will be voted on in November 1950. Any effort to jam legislation through would automatically make oil an outstanding issue in next year's congressional campaigns.

The producers, in fact, do not really expect to secure relief from Congress next year. Based on their experience in securing the original adoption of the import excise taxes, they estimate that 2 years or more of fighting will be necessary to convince Congress of the need for action.

Just the Must

THE House of Representatives got back into harness this week after a 3-week vacation, its major remaining task for the session being to work out agreements with the Senate on a number of bills now in conference.

Among the bills on which there are differences between the two chambers are two appropriations measures, for Interior and the Military Establishment, which should have been enacted before June 30. The House passed the Interior bill March 30 but the Senate didn't get around to it until August 25; the military appropriations went through the House April 13 but the Senate did not act until August 29, and it has been necessary since June 30 for Congress to pass resolutions permitting the two departments to spend money in advance of appropriations so they could pay their employes.

Also tied up in conference are the bills legalizing the use of delivered prices and absorption of freight, ECA appropriations, minimum wages, and a number of less-important measures of no particular interest to the oil industry. The appropriation bills are "must" measures, but some of the others may be stalled indefinitely.

President Truman is still demanding that his full legislative program be acted upon before Congress adjourns, despite the pleadings of his congressional leaders to let them go home, but the indications are he has received about all he will get out of Congress this year and the session may end next month.

Going Up!

AMERICAN farmers are not only using more automotive equipment than ever before but they are making more use of what they have, the Department of Agriculture has discovered.

Recent studies indicated that farmers used about 7,550,000,000 gal. of liquid petroleum fuels, including liquefied petroleum gas, in 1947, and estimates place the 1948 consumption at more than 8,200,000,000 gal.

About 40 per cent of the 1947 consumption was in tractors, 26 per cent in automobiles, 11 per cent in trucks, and 4 per cent in stationary and mounted motors. The remaining 19 per cent was used in farm households and for miscellaneous purposes. More than 70 per cent of the total consumption was gasoline.

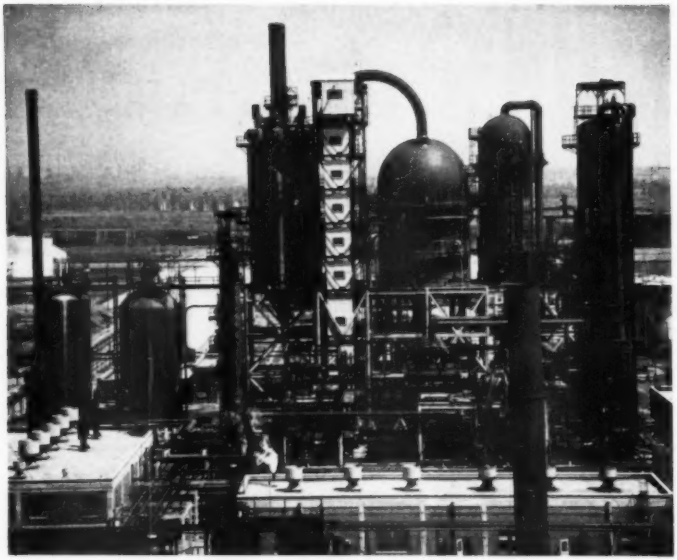
Consumption of motor oil on farms in 1947 was placed at about 163,000,000 gal., plus an unestimated amount used for electric motors and for lubricating farm machinery other than power machines.

In 1947, the department found, the average farm-tractor owner used 946 gal. of fuel, of which 80 per cent was gasoline, 6 per cent distillate, 4 per cent diesel fuel, and 3 per cent kerosine, plus 7 per cent fuel oil and L.P. gas, tractor fuel, and power fuel.

The average farmer used about 400 gal. of motor fuel and drove his automobile 6,400 miles—more in the western half of the country and less in the East. He drove his truck about 5,200 miles and used 445 gal. of fuel—more in the South and less in the Northeast.

About 4 per cent of the farm liquid-fuel consumption was used in stationary and mounted internal combustion engines, above-average use being noted in states where large combines are widely used in harvesting or where deep wells supply large quantities of irrigation water.

Almost 19 per cent of the liquid fuels, including L.P.G., were used in farm households and for miscellaneous farm uses. More of these fuels are now used in the farm home than ever before for cooking, heating homes and water, refrigeration, and other household uses, the department found.



New fluid catalytic cracking unit at the Cities Service refinery

East Chicago Expansion Completed

CITIES SERVICE OIL CO. last week celebrated the completion of a $20,000,000 expansion and modernization program at its East Chicago, Ind., refinery.

Guests touring the 35,000-bbl. refinery saw the two major projects around which the expansion program was planned—a fluid catalytic cracking unit with a 14,760-bbl. daily charge capacity and a new delayed coking unit with a charging capacity of 17,500 bbl. and a daily output of 326 tons of coke.

Also included in the huge program were revamped gasoline treating, light-ends recovery, and gas-purification units, and a revamped thermal recovery unit. Engineering design and construction was by M. W. Kellogg Co.

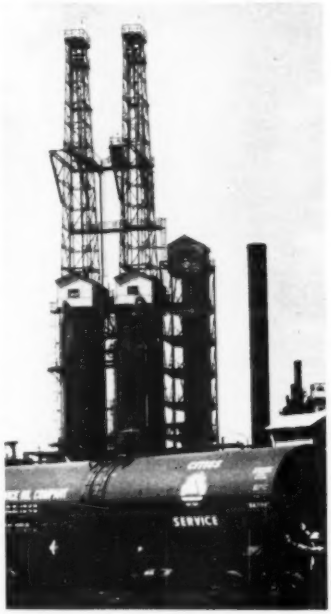
The cracking unit was built at an approximate cost of $7,000,000. The delayed coking unit cost about $3,000,000.

The refinery operates on Mid-Continent crudes moved to Chicago by the Texas-Empire and the Basin pipeline systems and connecting carriers.

Actual construction work on the expansion program required almost 2 years. The refinery-improvement project was a part of a company-wide modernization program. *(For a report on the over-all program, see The Oil and Gas Journal, March 24, page 177).*

The new cracking unit has a gas-oil conversion capacity of 10,300 bbl. daily and a coke-burning capacity of 15,000 lb. per hour. Catalyst circulation is at the rate of 20 tons per minute.

The delayed coking unit has two coke drums, each with a 326-ton capacity. The drums measure 17½ by 68 ft.



New delayed coking unit

A.G.A. Chicago Meeting Expected to Draw 5,000

APPROXIMATELY 5,000 persons representing all branches of the gas industry, both natural and manufactured, will converge on Chicago the week of October 16 for the thirty-first annual convention of the American Gas Association.

The convention continues through October 20.

The only meeting of the natural-gas department is Monday, October 17. D. A. Hulcy, president, Lone Star Gas Co., and department chairman, will preside and give a review of natural-gas developments. Another speaker, not yet definitely chosen, will discuss offshore drilling and Continental Shelf gas reserves.

The third talk at this meeting will be by Warren T. Bulla, Natural Gas Pipe Line Co. of America, Chicago, and vice chairman of the A.G.A. committee on mobile radio. He will speak on effects of the recent Federal Communications Commission order which for radio frequencies groups gas distribution with electric power and gas transmission with oil pipe lines.

Of interest to the petroleum industry are the several talks in the technical sessions dealing with the use of oil for the production of manufactured gas.

A number of A.G.A. awards for distinguished service in the industry will be presented at the general sessions. Hugh H. Cuthrell, vice president, Brooklyn Union Gas Co., and now first vice president of the association, is scheduled to succeed Robert W. Hendee, president, Colorado Interstate Gas Co., as A.G.A. president in conformity with the association's practice of alternating its chief officer between the natural and manufactured-gas branches. Hulcy, now second vice president of the association, is to become first vice president, and George F. Mitchell, president, Peoples Gas Light & Coke Co., Chicago, has been nominated to become second vice president.

Doheny Oil Properties Sold for $35,000,000

LOS ANGELES. — The Doheny properties in Fresno County, California, were sold last week by Mrs. Carrie Estelle Doheny to Nassua Associates, Inc., for $35,500,000.

The properties transferred comprise 2,570 acres in the Coalinga Nose area, Pleasant Valley field, and Guijarral Hills field. Present production is from 72 producing wells with a total daily output of 6,000 bbl.

Production from these properties is covered by a long-term contract with Union Oil Co. to take all production.

Nassua Associates, Inc., is a subsidiary of Dillon, Read & Co.

Division of World Oil Markets To Be Proposed in Discussions

WASHINGTON.—A division of world oil markets appeared as an eventual possibility this week as British, Canadian and United States experts prepared for considerations designed to provide a basis for future discussions of the international petroleum problem between higher officials of the three countries.

A state department announcement of the talks said merely: "It is anticipated that the complexity of the problem will require that the discussions continue for some time."

The department said the United States representatives will be led by Assistant Secretary of State George W. Perkins, while Sir Henry Wilson-Smith will head the British delegation and R. M. Keith will lead the Canadian group.

The purpose of the meetings, it was stated, will be to "analyze oil transactions affecting the sterling area" with due regard to the interests of the countries and companies concerned.

Expansion Plans Involved

The question of oil involves England's plans for expansion of her industry and increased participation in world trade as well as bilateral agreements which shut the United States companies out of important markets, such as that recently entered into with Argentina.

A hint that a division of world oil markets might be the answer was given in a joint statement on the results of the conference, in which it was said: "It was mutually recognized (during the recent economic discussions) that the question of oil production and refining, and geographical distribution raised problems of extreme complexity involving the protection of legitimate interests of the major producing countries and companies."

A somewhat similar idea appeared to prevail among some members of Congress, with Sen. George W. Malone of Nevada charging on the Senate floor that the study to be made of means for increasing Britain's dollar income from oil "is merely another method of cutting the United States out of foreign markets and enterprises."

More Refineries Planned

Malone declared that when the trans-Arabian pipe line is completed several refineries will "probably" be built in Arabia and nearby countries, and "then," he said, "the European countries will not only be self-sufficient but the world supply of oil will be increased. England can sell oil to the Argentina. England can sell oil to the United States. Even now that is resulting in a reduction in the oil production in the oil-producing areas of the United States."

When the conferences get under way, the United States is expected to have two major objectives in mind. It is expected to demand that, for one thing, American companies selling oil in the sterling area be permitted to convert at least part of their sterling income into dollars. Such convertibility is not now provided for, but the view in Washington is that United States companies operating abroad cannot be expected to go on indefinitely piling up funds in foreign countries which they cannot make use of, even though convertibility may add something to the drain on dollar exchange.

The second objective is seen as the discouragement of bilateral agreements. Following the consummation of the Argentine arrangement, England is understood to be eying similar agreements with other Latin American countries now served by United States companies.

There is, however, a third angle to the situation. That is the protests of the domestic independent producers against the further opening of United States markets to foreign oil. This point is bound to come up in any discussion of England's plans to export oil, which are known to contemplate exports to this country.

Indiana Standard Reduces Prices at Several Points

Action of the Standard Oil Co. (Ind.) in abandoning the Group 3 method of pricing its products *(The Oil and Gas Journal, September 15, page 58)* has so far not affected general tank-car quotations in Mid-Continent and Middle West markets although tank-wagon and dealer quotations on gasoline, furnace oil, kerosine and range oil, as newly posted by the Indiana Standard, are lower at many points. Standard of Indiana under its new pricing program is not announcing, at its Chicago headquarters, the quotations which now have a local base of postings at bulk stations.

In Kansas City, where gasoline prices have been subnormal, no changes were made in tank-wagon and dealer prices but tank-wagon quotations on kerosine, No. 2 furnace oil, and range oil were lowered 0.4 cent. The new prices per gallon are: kerosine, 13.2 cents; No. 2, 10.7 cents; and range oil, 11.7 cents. The company made a greater reduction in diesel fuel, explaining that in the future that high-speed diesel oil would take the range oil price and low-speed diesel, the No. 2 furnace-oil price.

In Minneapolis, tank-wagon and dealer prices on gasoline were reduced 0.4 cent and in Chicago 0.5 cent. The new dealer prices on housebrand gasoline in Minneapolis are 16 cents, exclusive of federal and state taxes, with the premium grade 1.5 cents higher. In Chicago the dealer price on housebrand gasoline was reduced from 15.9 to 15.4 cents per gallon.

Imperial Oil Planning Refinery at Winnipeg

TORONTO, Ont. — Announcement has just been made that Imperial Oil, Ltd., has acquired a site of approximately 400 acres on the east bank of the Red River in the outskirts of Winnipeg for a refinery.

Actual engineering plans are now being completed, but no date has been indicated for construction to commence. Plans are being developed with Hon. J. S. McDiarmid, minister of mines and resources for Manitoba; R. E. Grose, director of the commerce and industry department; and other provincial and municipal officials.

Crude will ultimately be delivered to Winnipeg by the new pipe line from Edmonton to Superior, Wis., construction of which was recently approved.

Independents Protest Proposed Mexican Loan

AUSTIN.—Sharp criticism of a proposed oil loan to Mexico was voiced here last week by the executive committee of the Texas Independent Producers and Royalty Owners Association.

"Americans once developed a considerable oil industry in Mexico. But shortly after an ambitious Mexican government expropriated their properties, the industry was reduced to its present state," declared Vernon W. Frost, Houston, vice president of the group.

In a prepared statement, Frost added: "Such a loan, designed to 'open unexplored areas and bring in additional wells in existing oil fields,' means subsidized competition for the already hard-hit independent producers in this country. It means, of course, additional imports when imports now are at the dangerous level of more than 600,000 bbl. daily.",

The blast by TIPRO at the Mexican loan came while Gov. Allan Shivers of Texas was in Mexico City on a good-will visit.

International

WORLD-WIDE OIL DEVELOPMENTS

Chinese Communists Suffering Acute Shortage of Petroleum

WASHINGTON.—Despite the fact that oil has been shipped to communist China from Russia, Manchuria, Hong Kong and—in American-owned tankers—Romania, information gathered by the State Department indicates the communists already are suffering from a severe petroleum shortage.

The Chinese communists claim that petroleum stocks of private firms and of the national government in north and central China amounted to 1,000,000 bbl. at the time those areas were occupied, of which it is estimated that 400,000 bbl. were stocks held by American firms, Asst. Sec. Ernest A. Gross said in a report to Sen. William F. Knowland of California.

The only important domestic source of petroleum available to the communists, Gross said, is the shale-oil refinery at Fushun, Manchuria, but the output of that plant reportedly has been reduced from 1,300,000 bbl. annually in 1943 to 100,000 bbl. now, due in part to Soviet stripping. The communists also control a large refinery at Hulutao, taken over intact when the Chinese Government forces withdrew from Manchuria, and another at Dairen under Soviet control, but both are said to be idle because of lack of crude supplies.

Gross told Knowland that the U.S.S.R. has supplied limited quantities of products to Manchuria since the war which probably were sufficient for limited communist requirements until the end of last year, and that arrangement is to be continued.

The department, he said, has received reports that approximately 200,000 bbl. of kerosine and gasoline were shipped from Constanza, Romania, to Dairen during the latter part of July. Further light on those shipments was shed by Vice Chairman Grenville Mellen of the Maritime Commission in a letter to the senator in which he said that two American-owned tankers had been chartered by a New York firm to carry the oil, reportedly without objection from the State Department.

Gross reported that communist North China has received some shipments of oil from Manchuria, the Soviet Union and Hong Kong this year, but interference with shipping at Shanghai by the nationalist government has prevented any imports of oil at that port since the latter part of June.

"The above sources of petroleum are believed to meet only a fraction of minimum requirements in communist-controlled areas of China and Manchuria," he said. "These minimum requirements have been estimated roughly at 5,000,000 bbl. annually. Indications of a severe petroleum shortage in communist China are to be found in the frequent demands of communist authorities that civilians cut down oil consumption, in the hasty conversion of the Shanghai Power Co. and other industrial plants from oil to coal, and in the installation of charcoal burners in motor vehicles."

Laying Gross' report and Mellen's letter before the Senate, Knowland said the use of American tankers to haul oil to the communists after the United States had spent large sums in aiding the national government in its effort to defeat them was reminiscent of pre-Pearl Harbor days "when the State Department of the United States was countenancing, at least, the shipment of scrap iron and oil to Japan."

Reds Seeking Substitutes

The shortage of petroleum products in Communist-held China is indicated by recent reports that increasing efforts are being made to develop synthetic production and other substitute liquid fuels.

The Communist New China News Agency said initial success has been obtained by many Shanghai companies in overcoming the petroleum shortage created by the Nationalist blockade. China Vegetable Oil Co. in Shanghai has succeeded in producing synthetic motor fuel and diesel from cotton seed oil, obtaining 24 lb. of gasoline as well as other products from each 100 lb. of cotton seed oil treated. The Hangchow Municipal Government is encouraging distillation of alcohol and use of charcoal and is supervising experiments on synthetic fuel at Chekiang University.

Not only the blockade but also the unfavorable attitude taken by the Communists in supporting exorbitant labor demands and in other matters have caused the American oil companies virtually to shut down operations in China. Expatriate staffs have been largely evacuated, and properties placed in charge of Chinese staff members.

Third Well in Jose Ruiz Concession Completed

Pancoastal Oil Co., C. A., and Venezuelan Atlantic Refining Co. have completed their third producer in the Jose Ruiz concession in Eastern Venezuela.

Florent H. Bailly, Pancoastal president, said the new well on a test flowed at the rate of 660 bbl. daily. It is a dual completion.

Production was 248 bbl. of 36°-gravity oil from the upper horizon and 412 bbl. of 28.2°-gravity oil from the lower.

Contract Let for 120 Houses at Amuay Bay

Creole Petroleum Corp. has awarded a $3,000,000 contract to the George F. Driscoll Co., New York, for the construction of 120 houses at the site of its new refinery at Amuay Bay in northwestern Venezuela.

The contract is in addition to a $4,000,000 project for 500 workers' houses at the refinery which are now being built by the Driscoll company. The new project provides for two to four-bedroom staff and management-official dwellings of concrete blocks and reinforced concrete.

Foreign Output Shows Decline In July; World Total Off 2%

by Dahl M. Duff

FOREIGN crude-oil production, excluding Russia and eastern Europe, showed another slight decline in July, dropping about 19,000 bbl. to a daily average of 3,414,400 bbl.

Most of the over-all foreign drop in July was the result of a cutback of more than 80,000 bbl. daily in Saudi Arabia. This more than balanced the smaller gains in production reported in Venezuela, Iran, Iraq, and other countries.

The decline in Saudi Arabian production to slightly more than 400,000 bbl. daily brought the total for the entire Middle East area to 1,338,700 bbl. daily, its lowest level thus far this year. High point was reached in April with 1,485,200 bbl. daily.

United States crude production was off sharply in July. The daily average was 4,733,000 bbl. about 170,000 bbl. daily or 3.4 per cent under June. As a result of this, total world production, including the United States and the estimated Russian output, dropped back about 2 per cent, or about 184,000 bbl. daily, to 8,890,800 bbl. daily.

Western Hemisphere Up

In the Western Hemisphere, excluding the United States, crude production continued its recent upward trend. The July daily average of 1,786,200 bbl. represented a gain of 17,400 bbl. daily over the previous month and brought the total to its highest level since last December's 1,815,900 bbl. daily.

Lowest point came last March with a daily average of 1,625,900 bbl. daily. Venezuela's production, which makes up some 75 per cent of Western Hemisphere output excluding the United States, showed another slight rise in July to 1,307,000 bbl. daily, about 10,000 bbl. daily over the figure for June.

A more marked increase in Western Hemisphere foreign production is indicated for August. The Venezuelan production figure for that month has been reported at 1,373,000 bbl. daily.

Elsewhere in the Western Hemisphere, July production was largely unchanged or only slightly greater than the June figure. Recent reports are that production in Bolivia has been markedly increased in the last few months. Mexico's production was reported at 168,300 bbl. daily in July, 10,000 bbl. daily or more above the daily average of earlier this year. The July output included 100,003 bbl. daily from Poza Rica, 17,048 bbl. daily from the Isthmus region, 25,529 bbl. daily from the northern area, and 21,887 bbl. daily from the southern area.

International

German production set another postwar record. The daily average was 76,159 metric tons, or about 17,400 bbl. daily. Of this, 35,626 tons came from the Hanover area, 31,053 tons from Emsland, and 8,976 tons from Schleswig Holstein-Hamburg. A slight increase was shown in production in continental France. Reports from Paris said this was due to the new well brought in in the vicinity of Soultz-sous-Forets.

Of particular interest in Middle East production in July was the relatively large increase reported in Iraq. Crude production in that country rose from about 76,000 bbl. daily in June to nearly 110,000 bbl. daily in July, a gain of about 45 per cent. This was due to the opening of the new 16-in. pipe line to Tripoli, and further increases in Iraq production are expected as the line goes into full operation. Iraq production was cut back to about 60,000 bbl. daily after the pipe-line outlet through Palestine to Haifa was closed down in the spring of last year.

Another increase in production in the Middle East was that reported for Iran. Output was up from about 550,000 bbl. daily in June to 567,300 bbl. daily in July.

The other two major Middle East producers both reported a drop in July production. Kuwait was down 9,100 bbl. daily to 230,400 bbl. daily, a drop of 3.8 per cent. The sharp drop in production in Saudi Arabia was attributed largely to marketing difficulties arising out of the dollar shortage in many foreign areas. In addition, the market for Middle East oil has been adversely affected by the Communist Government in China, decreased imports into the United States, and lesser demand in some European areas.

Little change was indicated in production in the Far East. Lack of information on the British-Dutch controlled production in Indonesia prevents an accurate appraisal of that important area.

CRUDE-OIL PRODUCTION
(Thousands of barrels daily)

Country—	July	Previous month
Western Hemisphere:		
Argentina	62.5	62.4
Bolivia	2.5	1.9
Brazil	0.1	0.1
Canada	58.2	54.8
Colombia	84.0	83.5
Cuba	0.6	0.2
Ecuador	7.5	7.1
Mexico	168.3	166.2
Peru	40.0	40.5
Trinidad	55.5	55.0
Venezuela	1,307.0	1,297.1
Total	1,786.2	1,768.8
Europe and Africa:		
France	1.2	1.1
French Morocco	0.4	0.4
Germany	17.4	16.5
Italy	0.2	0.2
Netherlands	11.4	11.8
Egypt	43.9	43.7
United Kingdom	0.9	0.9
Total	75.4	74.6
Middle East:		
Bahrein	30.1	29.9
Iran	567.3	549.3
Iraq	109.9	75.9
Kuwait	230.4	239.5
Saudi Arabia	401.0	481.1
Total	1,338.7	1,375.7
Far East:		
British Borneo	70.0	70.0
Burma	0.4*	0.5
China	1.8	1.8
India	5.3	5.3
Indonesia	125.0	125.0
Japan	3.8	3.8
New Guinea	5.9	5.9
Pakistan	1.9	1.9
Total	214.1	214.2
Total, foreign less Russia & E. Europe	3,414.4	3,433.3
Russia and E. Europe:		
Albania	1.0	1.0
Austria	17.7	17.7
Czechoslovakia	0.9	0.9
Hungary	10.0	10.0
Poland	2.7	2.7
Romania	80.0	80.0
Russia	630.0	625.0
Yugoslavia	1.1	1.1
Total	743.4	738.4
Total foreign	4,157.8	4,171.7
United States	4,733.0	4,903.0
World total	8,890.8	9,074.7

TREND SINCE JANUARY 1, 1949

	W. Hemisphere less U. S.	Middle East	Foreign less Russia & E. Europe
January	1,706.4	1,358.2	3,308.6
February	1,688.6	1,400.2	3,340.9
March	1,625.9	1,393.4	3,280.2
April	1,678.2	1,485.2	3,448.3
May	1,768.5	1,417.6	3,472.8
June	1,768.8	1,375.7	3,433.3
July	1,786.2	1,338.7	3,414.4

The monthly production figures are authoritative for all countries in the Middle East and the more important producing countries in the Western Hemisphere and Europe. In some other cases, estimates have been made based on the performance of preceding months. Figures in the column "previous month," do not agree in some instances with those heretofore published for June since revisions have been made due to subsequent information. Data for Colombia and Canada do not include condensate. Figures for Russia and the Russian-dominated countries are the latest obtainable.

Oil Search in Cuba:

Gulf Begins New Exploratory Test

ANOTHER effort in the long series of attempts to find substantial oil production in Cuba has been undertaken by Cuban Gulf Oil Co.

The company, a subsidiary of Gulf Oil Corp., has begun a deep wildcat test located about 3½ miles offshore in Cardenas Bay on the north coast of Cuba. It is about 8 miles from the city of Cardenas and southeast of Diana Key.

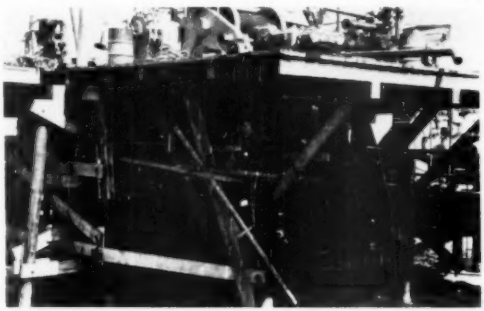
The platform supporting the heavy steam rig and other equipment was built in about 13 ft. of water with the piling set in coral lime rock. The well is now reported to be drilling at about 1,000 ft.

The Gulf Hicacos test is approximately 60 km. northwest of Motembo field in Matanzas Province which was discovered in 1880 and produces less than 200 bbl. daily. Minor production also is obtained in Jarahueca field in Santa Clara Province to the east and in Bacuaranao field in Habana Province to the west.

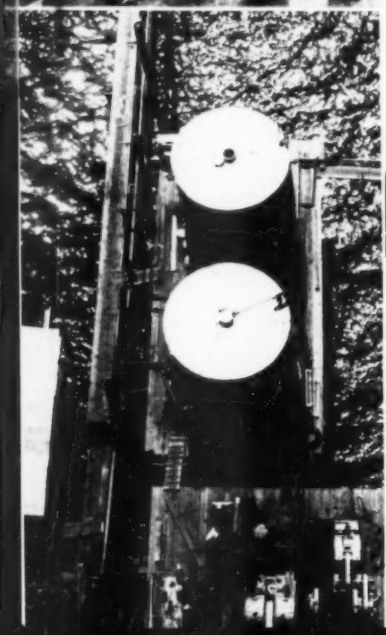
Efforts to develop more sizable production in Cuba have been made intermittently for more than 40 years. Though this is Gulf's first well, a number of other wildcats have been drilled by other operators, the latest being the Shell Group's 10,563-ft. test which was abandoned in August 1947.

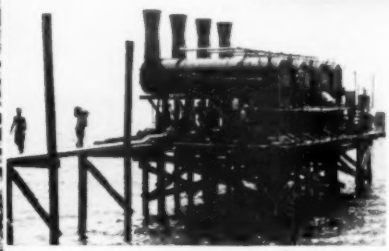
At Motembo field, the pay is in the Upper Eocene from a monoclinal igneous structure. Since the oil did not originate in these serpentine rocks, much of the exploratory effort has gone into finding the source beds and much more substantial accumulations in sedimentary formations. The production from Motembo is almost pure natural gasoline with a gravity of 58° to 61° and produced with low gas-oil ratios.

Spudding in of the well August 12 was made the occasion of a ceremony which was attended by the president of the Cuban Republic and other high officials of the government.



Left: Dr. Carlos Prio Socarras, president of Cuba, christens the operation at ceremony marking start of drilling. At right in white suit is R. J. Macaulay, resident manager for Cuban Gulf. Right: Closeup view of the platform supporting the rig





Left: Looking down from the derrick on some of the rig equipment and tanks at the Cuban test. Above: Boiler arrangement for the offshore wildcat. Right: The Gulf Hicacos well, with barge in foreground

Antwerp Refinery to Be Third Such Postwar Project in Area

THE 25,000-bbl. refinery to be built in Antwerp, Belgium, by Esso Standard Refinery, is the third refinery projected for Belgium and the Netherlands since the end of the war.

Caltex Petroleum Mij. now has under construction at Pernis, near Rotterdam, a 20,000-bbl. refinery. Another 20,000-30,000 refinery is being started at Antwerp by Soc. Industrielle Belge des Petroles, S.A., jointly owned by Anglo-Iranian Oil Co., Ltd., and Finaciere Belge des Petroles, S.A. (Petrofina).

Plans for the new refinery were announced recently by Standard Oil Co. (N. J.). The new company formed to build and operate the refinery is separate from Jersey Standard's present marketing company in Belgium, Cie. Industrielle Atlas, S.A., which now has a 2,000-bbl. daily skimming plant in Antwerp.

Construction is expected to get under way in the next few months. All specifications and estimates for the project are not yet completed. The refinery, to include thermal cracking facilities, will produce high-grade gasoline, kerosine, fuel oil, and automotive and industrial diesel fuel.

Much of the existing refining capacity of Belgium and the Netherlands is in the Pernis plant of N.V. de Bataafsche Petroleum Mij. (Shell) which last year processed an average of about 33,000 bbl. daily, about a third of which was Netherlands' production at Schoonebeek.

Belgium now has a refinery capacity at about 11,000 bbl. daily in several small refineries, some of which are being expanded. Completion of all these projects will provide sufficient refining capacity to meet normal product demands of Belgium, the Netherlands, and Luxemburg with some slight surplus for export. Petroleum imports of the three countries, including crude oil, last year averaged about 87,300 bbl. daily, with 40,000 bbl. daily to Belgium and Luxemburg, and about 46,800 bbl. daily to the Netherlands.

International

14 Wells to Be Drilled in Manantiales Field in 1950

Corporacion de Fomento, operating unit of the Chilean Government, has completed 12 wells in the Manantiales field in southern Chile. Three wells are now drilling.

The commercial production of the field awaits the completion in 1950 of a line from Spring Hill to Bahia Blanca now under construction. The company has plans to build a refinery with thermal cracking facilities. Manantiales field is one of the important discoveries of 1945. The crude is a white paraffinic base with a 40° A.P.I. gravity.

48-Mile Pipe-Line Outlet For Ganso Azul Planned

Cia. de Petroleo Ganso Azul, Ltda., with offices in Lima, Peru, is now considering the laying of 48 miles of 4-in. pipe line from Ganso Azul field to the town of Pucallpa on the Ucayali River, in Peru.

The field, which was discovered in 1938, is located east of the Andes Mountains, not far from the Ucayali River, which is a tributary of the Amazon River. The field consists of six well flowing from a depth of approximately 1,100 ft. and the current production is 750 bbl. daily. The crude is refined in a 1,000 bbl. skimming plant at Rio Pachitea and the products are distributed by water transportation in that general area.

I.P.C. Seeking Syrian Right-of-Way

IRAQ PETROLEUM CO., Ltd., has made application to the Syrian Government to the new right-of-way required to terminate its proposed 30-32-in. crude pipe line at Banyas on the Syrian Coast.

According to reports from Beirut, Lebanon, the proposed line will branch off the present I.P.C. pipe-line route near Homs, Syria, and extend northward to a terminal at Banyas.

This 30-32-in. line is still in the planning stage. It is expected to follow the route of the existing 12 and 16-in. as far as Homs. The company has in the past built its own lines but it is known to be considering American contractors for the big-inch project.

The I.P.C. 30-32-in. is one of four lines to the Mediterranean which have been projected. When completed as originally planned, they will deliver some 1,700,000 bbl. daily to the Mediterranean and will make a 160-mile section of the Syrian and Lebanon coasts probably the world's largest oil shipping area.

The Trans-Arabian Tapline will end at Sidon south of Beirut. Work continues on this project, and no difficulty is foreseen as a result of the recent overthrow of the Syrian Government which signed the transit agreement earlier this year. Tartus or Latakia have been mentioned as the terminal of the projected Middle East Pipe Line, Ltd., project. Apparently least advanced is the large-diameter line or lines planned to carry Kuwait production to the coast.

Next Week

THREE different operating methods for decreasing residual fuel oil production in favor of distillates are discussed by George Armistead, Jr., in his article "Control of the Production of Residual Fuel Oil." Flow schemes on the three methods along with yield comparisons and investment requirements for plant conversion are included in this article.

The series of charts included in the article "Specific Heats of Natural Gases" by Paul Buthod, associate professor of Refinery Engineering, University of Tulsa, and coauthor of the popular articles on heat exchanger design published in the Journal, offer the engineer a rapid method for determining specific heats of natural gases in the pressure range from atmospheric to 5,000 psi.

A detailed report on the equipment hookup for the highest-pressure flowing well yet discovered on the Gulf Coast, is given on this 7,900-psi. operation by Leigh S. McCaslin, Jr., the Journal's district editor in the Gulf Coast area.

Rich-oil stabilization, a new development in natural-gas field-processing operations, is discussed in an article by S. Goldblatt and H. M. Nelly, Jr. How the method compares with conventional processes is clearly illustrated with schematic drawings and text.

The article "Jacket Type Foundations" by M. B. Willey, describes how this type of substructure was adapted to marsh locations.

In his discussion, "Evolution of the Petrochemical Industry," Charles W. Perry takes into account the raw materials, separation methods and derivatives of hydrocarbon chemicals as related to current operations.

PERSONALS

Martin Well Qualified In New Gulf Position

WITH a background of more than 20 years of service in Gulf Oil Corp.'s production department in Louisiana and West Texas, B. G. Martin, recently appointed assistant to J. H. Russell, vice president in charge of production, enters his new assignment with a well-rounded knowledge of the producing phase of the oil industry and the problems pertinent to Gulf's operations.

Martin was division geologist in Houston before his new appointment, and prior to that was a production engineer in the company's geological office in Fort Worth.

Joining Gulf at Midland, Tex., in 1928, Martin served continuously with the firm with the exception of two leaves of absence. The first leave was granted so that he could continue his geological studies at University of Oklahoma; the second so that he could serve as production analyst and conservation engineer in Houston for Petroleum Administration for War during World War II.

He is a member of the American Association of Petroleum Geologists, and the Houston Geological Society.

Walter R. Berger, Jr., geologist for Humble Oil & Refining Co. at Jackson, Ala., has been transferred to the Tallahassee, Fla., geological offices.

R. T. Sellars, independent oil producer, has moved from Monroe, La., to Decatur, Tex.

John C. Baxter, geophysicist for Gulf Research & Development Co., has been transferred from Pitt, Pa., to Houston as laboratory technician.

Richard B. Smith, petroleum engineer at Fort Worth for Continental Oil Co., has been transferred to the Todd field in Crockett County, Texas, in the same capacity.

Frank M. McMahon, Calgary, Alta., Canada, has been named a director of Western Canada Petroleum Association. He is president of Pacific Petroleums, and is associated with Peace River Natural Gas Co. and Atlantic Oils, Ltd.

Ken R. Burns, petroleum and geological engineer, has opened offices in Tulsa and will conduct business under the name of Ken R. Burns Engineering & Producing Co. A district office will be maintained in Wichita Falls, Tex.

Dr. Harvey T. Kennedy has joined the staff of the petroleum-engineering department, Texas A. & M. College as professor of petroleum engineering. He has held a number of important positions with U. S. Bureau of Standards, and from 1930 to 1949 was chemist, section chief, and assistant chief of the materials and production-chemistry division, Gulf Research & Development Co., Pittsburgh.

Lester S. Grant, Midland, Tex., retired director and vice president of Franco-Wyoming Oil Co., will be among a group of alumni of Colorado School of Mines who will receive the school's distinguished-achievement medal at the convocation in observance of the institution's seventy-fifth anniversary September 29. Grant formerly was professor of mining at the school, and from 1921 to 1927 served as dean of the faculty.

Tom Hower, formerly head of the reserves section of the geological department, Skelly Oil Co., has joined the firm of **Raymond F. Kravis,** consulting-valuation engineer, Tulsa. Before joining Skelly in 1947, Hower was with Shell Oil Co. for about 12 years as production and valuation engineer.

Paul L. Lyons, Tulsa, has been appointed technical assistant to **H. F. Moses,** vice president in charge of exploration and research for Carter Oil Co. In the newly created position Lyons will be in charge of coordinating geological and geophysical work throughout Carter's entire operating area. He has been with Carter 14 years and is a graduate of DePauw University.

Herbert Lee McCracken has been appointed to the engineering staff, Texas Railroad Commission, and will be headquartered in Kilgore. Other commission appointments include: **Charles F. Qualia,** assigned to the Midland office, and **Henry Y. Cornelius,** who will be headquartered in Pampa. **A. H. Barbeck,** petroleum-engineering consultant and former commission engineer, has rejoined that body as assistant to the chief engineer.

E. L. Shafer, petroleum engineer in the Fort Worth regional office of Continental Oil Co., has been appointed superintendent of the New Mexico district, with headquarters at Hobbs. He replaces **A. B. Owen,** who was transferred to the Wichita Falls, Tex., district as assistant drilling superintendent. **D. F. Jacobs,** formerly assistant superintendent at Big Spring, Tex., has been transferred to the same position in the New Mexico district, replacing **D. W. Prescott,** who resigned to join Superior Oil Co.

W. H. Barclay has been appointed assistant general superintendent of production for Midstates Oil Corp., Tulsa. He has served for 28 years in the oil business as field clerk, accountant, secretary, and production superintendent, and is a former officer of the Tulsa Purchasing Agents Association and Petroleum Motor Transport Association. Barclay formerly was with Marland Oil Co., and Tide Water Associated Oil Co. before joining Midstates.

A. W. Vitt, formerly assistant chief geologist for Seaboard Oil Co. of Delaware, Los Angeles, has been moved to Casper, Wyo., as chief geologist for the Rocky Mountain area. **Jack Fanshawe** is division manager for the company's Casper office.

Howard D. White, executive vice president of Liquefied Petroleum Gas Association, will resign October 31 to enter private business in Albuquerque. He has been executive vice president of the association for the past 4 years.

J. W. Darnell, assistant district landman for Sinclair Oil & Gas Co. at Clinton, Okla., has resigned to enter business for himself, and has been replaced at Clinton by **John C. Noble,** formerly of Oklahoma City.

S. Miller Williams, Jr., president of Williams Brothers Co., was recently decorated with the Order of the Condor of the Andes by **Mamerto Urriolagoitia,** president of Bolivia and grand master of the order, at a banquet in La Paz. The order is conferred on foreigners for distinguished service to Bolivia, and Williams was decorated in recognition of his accomplishments in construction of the 255-mile, 6-in. Camiri-Cochabamba - Sucre pipe line. At another ceremony at Cochabamba, certificates of merit were presented by the state governor to **George Allen,** general superintendent and project manager; **Ward Stalnaker,** superintendent in charge of stations; and **J. E. Melanson,** office administrator for Williams Brothers.

S. WILLIAMS, JR.

F. S. Wade, president and general manager, Southern California Gas Co., Los Angeles, has relinquished the title and duties of general manager, and remains president of the firm, and **F. M. Banks,** formerly vice president and assistant general manager, has been named vice president and general manager of the company. **J. G. Rollow,** supervisor of the engineering, gas production, and transmission department, has retired from the firm after more than 25 years' service.

Donald T. Howell, Shreveport, was recently elected assistant secretary-treasurer of United Gas Corp. He is in charge of the company's New York City offices.

Robert W. Brinkerhoff has moved to Calgary, Alta., Canada, as resident manager for Brinkerhoff, Ltd., new Canadian subsidiary of Brinkerhoff Drilling Co.

Brice Bloodgood has been assigned to an engineering post at Cities Service Gas Co.'s compressor office in Wichita. He is a graduate of Cornell University, holding a degree in engineering.

Eugene Hardison, formerly with Union Oil Co., recently joined the staff of Federal Power Commission in Washington, D. C. During World War II Hardison served with Petroleum Administration for War.

Hugh James Denison has been appointed assistant controller and assistant treasurer of Union Gas Co. of Canada, Ltd., at Chatham, Ont. He formerly was with Steel Co. of Canada, Ltd., at Hamilton, Ont., as supervisor of accounting.

John E. Lindroth, assistant secretary, Standard Oil Co. (N. J.), has been appointed budget director of the company, replacing **C. L. Burrill,** who resigned to join Creole Petroleum Corp., affiliate of Jersey Standard.

Howard B. Nichols has been named a director, vice president, and member of the executive committee of California Texas Oil Co., Ltd., and a director of Bahrein Petroleum Co., Ltd., of which he is now a vice president and member of the executive committee. In these new offices he succeeds the late D. J. Hanna. Nichols has been with the Caltex - Bahrein group since January 1938 and previously assisted in the design of Bahrein's refinery on the Persian Gulf, which was begun in 1936. He has been engaged in petroleum refining since 1923, and is a graduate of Stanford University. He became manager of research and development of Bahrein Petroleum in 1938, was elected assistant vice president in 1944, and vice president of refining in 1947.

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Carl H. McAlister has opened geophysical consulting offices in the Orpheum Building, Tulsa, where he will interpret seismic data in the Mid-Continent and Gulf Coast areas.

F. W. Sharp, formerly first assistant treasurer of American Light & Traction Co., has been elected vice president and treasurer of American Natural Gas Co., successor to the former company.

Joseph Jackson, production superintendent for Imperial Oil, Ltd., at Entrance, Alta., Canada, has been moved to the Wembley, Alta., Canada, area in the same capacity.

Charles W. Hamilton, vice president of Gulf Oil Corp., and director of foreign production for the company, has been elected to the board of Montclair Savings Bank, New York City.

H. F. Peterson, Shell Oil Co., Los Angeles, will teach a special course in petroleum map drafting, refinery equipment, and engineering at the University of California during the 1949-50 school term.

H. G. Henderson, of Severns Drilling Co., recently was named a member of the administrative committee, Conservation Committee of California Oil Producers.

James W. Vanderbeek, Stanolind Oil & Gas Co. geologist working out

The proposed oil loan to Mexico and the Thomas amendment to the Reciprocal Trade Agreements Act were the major topics discussed by this group of independent producers and royalty owners in Austin last week. Members of the executive committee of the Texas Independent Producers and Royalty Owners Association shown here are, left to right: B. B. Orr and Bryan D. Beck, Longview; Ralph U. Fitting and W. P. Z. German, Midland; W. E. Turner, E. I. Thompson (standing), Austin; Guy I. Warren, Corpus Christi; Bert Fields, Dallas; L. A. Douglas, San Antonio; E. A. Ellison, Tyler; R. L. Foree, Dallas; and William T. Beard, Jr., San Antonio. ***(For story of meeting, see page 143)***

PERSONALS

of the Casper, Wyo., office, has been transferred to the company's geological offices in Calgary, Alta., Canada.

Charles E. Myler, president of Muskegon Development Co., Michigan oil-development firm, has been elected president of Old Dutch Refining Co., Muskegon, filling the vacancy caused by the death of E. J. Bouwsma.

D. E. Witt has been named assistant division land man for the Oklahoma division, The Texas Co.'s producing department, and will assist in coordinating Texas Co. operations in Oklahoma, Kansas, Illinois, Indiana, Kentucky, and Michigan.

H. C. Vanderpool was recently elected president of the Fort Worth Geological Society, replacing **Frank C. Schouten.** He formerly served as that group's vice president. **W. Baxter Boyd,** Continental Oil Co., was named vice president of the society.

R. E. Duty, former division geologist for W. C. McBride, Inc., has resigned to become an independent consultant, and has opened offices in Mount Vernon, Ill.

SHIFTS—

Alfred H. Waldchen, refinery engineer, Standard Oil Co. of California, El Segundo to Bakersfield, Calif.; **Peter H. Gardett,** engineer, General Petroleum Corp., Laguna Beach, Calif., to Los Angeles; **C. R. Crim,** engineer, Humble Oil & Refining Co., Thompson to Tomball, Tex.; **Melvin Loader,** superintendent, West Central Drilling Co., Merkel to Abilene, Tex.; **M. R. Mullins,** Pure Oil Co., Aleif Tex., to Thibodaux, La.; **M. D. Frazier,** engineer, Humble Oil & Refining Co., Clint to Hawkins, Tex.; **M. L. Mills,** superintendent, T. G. & M. Drilling Co., Falls City to Alice, Tex.; **Homer E. Roberts,** geologist, Petty Geophysical Engineering Co., Post to Midland, Tex.; **E. C. Hines,** superintendent, Texas Hi-Grade Oil Corp., Conroe, Tex., to Huntington, W. Va.; **Elliott H. Powers,** geologist, Gulf Oil Corp., Fort Worth to Houston; **J. Elmer Thomas,** geologist, Fort Worth to Tulsa.

W. J. Wranosky, engineer, Magnolia Petroleum Co., Mirando City to Freer, Tex.; **E. R. Fleshman,** Phillips Petroleum Co., Muenster, Tex., to Topeka, Kans.; **Marsh S. Watson, Jr.,** engineer, The Texas Co., Plainview, Tex., to New Orleans; **Joseph E. Dinger,** Magnolia Petroleum Co., Premont to Iowa, Tex.; **C. O. Magee,** engineer, Humble Oil & Refining Co., New Orleans to Katy, Tex.; **R. O. Streuber,** geologist, Gulf Refining Co., New Orleans to Searsley, N. Y.; **W. K. Clark,** geologist, Macmillan Petroleum Corp., El Dorado, Ark., to Shawnee, Okla.; **Elmer H. Finch,** engineer, Beers & Heroy, Washington, D. C., to Dallas; **Harry F. King,** refinery engineer, Sun Oil Co., Blue Island, Ill., to Port Hueneme, Calif.

Frank E. James, refinery engineer, Wood River, Ill., to Manhattan, Kans.; **J. H. Bates,** engineer, Texas Eastern Transmission Corp., Oakland City, Ind., to Spiro, Okla.; **Paul Ottenstein,** refinery engineer, Socony-Vacuum Oil Co., Inc., Kansas City, Mo., to Norman, Okla.; **Howard H. List,** engineer, Shell Pipe Line Corp., Springfield, Mo., to Houston; **F. L. Wootan,** The Texas Co., Westville to Woodbury, N. J.; **George A. Speir, Jr.,** refinery engineer, Gulf Oil Corp., Aldan to Drexel Hill, Pa.; **G. A. Kearney,** superintendent, California Oil Co., McKees Rocks, Pa., to Good Hope, La.; **Henry W. Lam,** refinery engineer, Atlantic Refining Co., Philadelphia to Port Arthur, Tex.; **R. B. Davidson,** refinery engineer, Sun Oil Co., Camden, Me., to Troy, N. Y.; **C. E. Stewart,** engineer, Federal Power Commission, Colorado Springs to Shreveport, La.; **T. Dean Mundorf,** geologist, Gulf Oil Corp., Grand Junction, Colo., to Topeka, Kans.; **R. C. Cashin,** engineer, Phillips Petroleum Co., Pauls Valley, Okla., to Nocona, Tex.

E. W. Rickey, engineer, Kewanee Oil Co., Tulsa to Shidler, Okla.; **R. C. Hartman,** engineer, Socony-Vacuum Oil Co., Inc., Casper, Wyo., to Augusta, Kans.; **Glenn F. Park,** engineer, Socony-Vacuum Oil Co., Inc., Lindsey, Wyo., to Anthony, N. M.; **C. C. Smith,** geologist, Casa Grande, Ariz., to Taft, Calif.; **Frank R. Young,** engineer, Laguna Beach to Idyllwild, Calif.; **C. E. Van Gunby,** engineer, Santa Fe Exploration Co., Long Beach to Albany, Calif.; **B. F. Owings, Jr.,** National Geophysical Co., Lamesa to Rankin, Tex.; **W. A. Reeves,** National Geophysical Co., Inc., Dallas to Alliance, Alta., Canada; **Wilton B. Brown,** engineer, Western Geophysical Co., Abbeville to Lake Charles, La.; **Jacque L. Williams,** engineer, Humble Oil & Refining Co., Grand Isle to Metairie, La.; **Bradley Skinner,** engineer, Phillips Petroleum Co., Denver to Bartlesville, Okla.; **Gerald P. Salisbury,** geologist, Union Oil Co. of California, Hardin to Cut Bank, Mont.

L. W. Folsom, geologist, California Co., New Orleans to Harvey, La.; **R. L. Johnston,** engineer, Shell Oil Co., Centralia, Ill., to Wichita, Kans.; **J. R. Ramirez,** engineer, Standard Oil Co. (Ind.), Hammond, Ind., to Calumet City, Ill.; **R. A. Malott,** Shell Oil Co., Afton, Wyo., to Ojai, Calif.

DEATHS

Morris E. Mockley, 56, Tulsa, president of Canal Refining Co. and Anchor Gasoline Corp., died September 17. He was supervisor of Amerada Petroleum Corp.'s gasoline-plant division from after World War I until that firm sold its plants to Natural Gasoline Corp. in 1935. He then became president of Natural. Mockley organized Anchor Gasoline Corp. in 1940. He was a native of Beloit, Kans., and was educated at University of Wisconsin.

Alonzo J. Balcom, 68, retired superintendent of communications facilities for Magnolia Pipe Line Co., died in Dallas September 8. A native of Brocton, N. Y., Balcom has served with Magnolia 34 years before retirement 3 years ago.

C. Raymond Myers, 65, Tulsa, member of the sales department of Mid-Continent Petroleum Corp., died September 16. He had been with the firm for 16 years.

Samuel Walter Emery, 71, who developed Nederkandsche Kolonial Petroleum Co.'s Dutch East Indies holdings, died in Houston September 15. He had been with Standard Oil Co. (N. J.) and its subsidiaries for more than 30 years.

R. M. Sackett, assistant division superintendent, Ohio Oil Co.'s pipe-line department, died September 9 in Casper, Wyo. He had been with the firm since 1919 and was appointed Wyoming division pipe-line superintendent.

Guy Carroll, retired assistant treasurer of The Texas Co. and a veteran of more than 45 years' service with that company, died September 15 in Lockport, Ill.

Sterling H. Diggs, 69, retired petroleum research chemist, died at Charlottesville, Va., September 5.

Capt. Louis Seipel, 51, Union Oil Co. tanker captain, died in Los Angeles September 11.

Howard P. McKalip, 71, Tulsa, independent oil operator, died September 17.

Making Hole

TECHNIQUES – EQUIPMENT – ECONOMICS

Dear Reader:

This annual "Drilling Contractors and Equipment" special issue has been entitled "Making Hole." That's because making hole, and in a big way, is exactly what the drilling tools of our industry are doing this year. The recorded figures to date show that this year a greater footage has been drilled than ever before in history. Total footage for all wells completed during the first 7 months of 1949 is 78,135,000 ft. This compares with 74,746,000 ft. for the same period last year. And last year's total drilled footage itself was a record breaker.

The editorial staff has planned this issue as a comprehensive presentation of interesting and informative articles on *the techniques, the equipment,* and *the economics* involved in this business of drilling and completing oil and gas wells. Other specially prepared feature articles tell about rig activity throughout the different active areas, give data on deep drilling, know-how for winter drilling, and other specialized operations.

The results of several months of intensive editorial effort appear in the publication, in this issue, of the Journal's new "Drilling Handbook." Included in this reference section is much practical, useful material under the major headings Rigging-Up, Prime Movers, Draw Works and Auxiliaries, the Drilling String, Drilling Muds, and Cutting and Fishing Operations.

Other features to be found include articles covering new developments in drilling equipment and practices, and the results of the Journal's recently completed questionnaire survey on "This Business of Contract Drilling."

The Editors

the OIL AND GAS JOURNAL
Annual Drilling Number

Who's who In A.A.O.D.C.

Officers, directors, and committee chairmen who direct activities of the organization

JOSEPH S. MORRIS

JOSEPH S. MORRIS, who is a partner in the contracting firm of Allen & Morris, San Antonio, traveled well over 15,000 miles this year in fulfilling his obligations as president of A.A.O.D.C. In addition to his routine duties he has been active in the I.P.A.A. and represented the contractors at meetings of the National Petroleum Council. During his term he has stressed better public relations, assisted in efforts to work out certain phases of contractural liability provisions, and sought to guide contractors in the adjustment to reduced operations.

FRANK M. PORTER, the association's vice president at large, is president of Fain-Porter Drilling Co., Oklahoma City. Long active in various oil industry organizations, he now is serving his second term as president of the Mid-Continent Oil and Gas Association. He is a director of A.A.O.D.C. and a member of its executive committee.

F. M. PORTER

A. W. THOMPSON

A. W. THOMPSON, president of Thompson-Carr, Inc., Houston, served as vice president for West Texas and New Mexico during the past year. A member of the research and education committee, as well as the executive committee, he has long plugged for educational courses such as the drilling-engine school which was started at Odessa last July.

D. B. FERGUSON, head of Ferguson Drilling Co. of Oklahoma City and Carmi, Ill., this year again was vice president for cable tools and chairman of the cable-tool committee. Under his guidance the committee laid the groundwork for an extensive cable-tool research program in an effort to improve upon their utility. Named a director in 1948, he also is a member of the executive committee.

AL BUCHANAN, president of the San Antonio drilling firm bearing his name, is vice president for the Gulf Coast area. For more than 40 years active in the drilling business, he drilled the discovery wells in several South

D. B. FERGUSON

AL BUCHANAN

R. W. WIRE

K. L. KELLOGG

J. V. DUNBAR

H. L. ROWLEY Z. K. BRINKERHOFF C. F. WHALEY L. A. BEECHERL BRAD MILLS

Texas fields and was among the first to conduct offshore operations on the Texas Coast. He was a director at large and a member of the executive and policy committees during the past year.

R. W. WIRE, president of Loffland Bros. Co., Tulsa, during the past year served as a director and vice president of the association for the Central Mid-Continent. As head of Loffland, one of the largest oil-well contracting firms in the world, he has taken an active interest in the company's extensive safety program.

KARL L. KELLOGG is vice president of the association for California. Head of the drilling company which bears his name, he started his oil-field experience in the cable-tool country around Bradford, Pa. His three sons, all active in the firm's California operations, constitute the "& Sons" in the company's name. He is also an association director and a member of the executive committee.

J. V. DUNBAR, who heads his Salem, Ill., drilling company, is vice president for the four-state area of Illinois, Michigan, Indiana, and Kentucky. A firm believer in the need for fellowship and better understanding among drilling contractors, he was well suited for the additional duty of chairman of the membership committee.

H. L. ROWLEY, who is vice president and coowner of Big Chief Drilling Co. of Mississippi, Shreveport, is association vice president for the Cretaceous and Tertiary basins. Beginning his oil-field career in southern Oklahoma, he managed Big Chief operations in Illinois during its boom days, then moved to Mississippi to enter that play. He is also a director and is a member of the tax and membership committees.

ZACH K. BRINKERHOFF, JR., is vice president of the association for the Rocky Mountain area, and is chairman of the Casper, Wyo., chapter which was organized this year. Copartner with his father in the firm of Brinkerhoff Drilling Co., Dallas, he supervises most of the company's drilling activities in Montana, Wyoming, Colorado, and Utah. The company in July expanded its operations into Canada upon taking a contract for a wildcat in Alberta Province.

C. F. (CHET) WHALEY, vice president for well servicing, is a native Californian who has been in the Southwest since 1920. An experienced cable-tool and rotary driller, with the reputation of being a stickler for details, he heads the Houston well-servicing company carrying his name. He is also a member of the executive committee and is an association director.

LOUIS A. BEECHERL, association treasurer, is one of the partners in the firm of McDaniel & Beecherl Drilling Co., Dallas. In addition he held the responsible job of chairman of the general arrangements committee for the 1949 meeting. His great interest in over-all drilling contractor activities is shown by the fact that he is also a member of the executive, tax, and accounting committees, as well as being a director at large.

BRAD MILLS, as executive vice president of the association, has been directly in charge of the group's expanded public-relations and educational programs. His oil-field experience dates from 1921 at Salt Creek, Wyo., and included 14 years of oil-publication work before he set up offices for the newly formed drilling contractors' association in March 1941 at Dallas. He has held his current position since early in the association's life. Earlier this year he was elected regent of the Dallas chapter of Nomads.

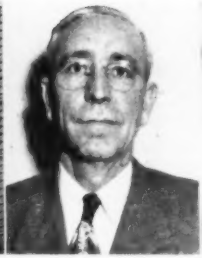
J. DOYLE SETTLE, association secretary, joined the A.A.O.D.C. in August 1944. He has been in charge of the industry-wide safety program which the association is sponsoring, and did much of the planning for the annual safety clinic held earlier this year in Dallas. Serving with OPA during the war years, he was a member of the Texas Legislature from 1935 to 1939 and later was assistant to the president of Texas Tech at Lubbock.

W. T. PAYNE, chairman of the policy committee, is president of Big Chief Drilling Co., Oklahoma City, and its associated companies. A past president of A.A.O.D.C., he also is a director and a member of the executive committee. As head of Big Chief, he has seen it expand during the past 13 years until today some 17 rigs are in operation and substantial oil production developed.

WARREN S. CHURCHILL, president of Arrow Drilling Co., Dallas, during the past year again headed the dues committee. A staunch believer in the importance of drilling contractors in the oil industry, he was one of the organizers of the association and is a director at large. His company operates largely in Texas and Oklahoma.

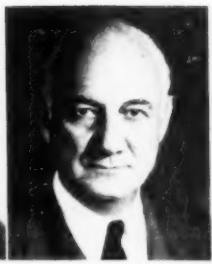
J. DOYLE SETTLE W. T. PAYNE W. S. CHURCHILL W. L. McCLUSKY THOMAS P. PIKE

C. J. PAINE



R. W. MARSHALL

C. W. ALCORN



J. E. BRANTLY

F. W. BRIGANCE

W. L. McCLUSKY, office manager for W. L. Delaney Co., Dallas, headed the accounting committee for the past 2 years, and had charge of registration at this year's convention. A former president of the Petroleum Accountants Society of Dallas, he has been a leader among drilling contractor accountants in working for more simplified and better organized accounting procedures.

THOMAS P. PIKE, chairman of the men and management committee, is well versed in employer-employe relations and is an originator of a management incentive program in which employes share in the profits. The Los Angeles drilling firm of that name, and of which he is president, has developed a reputation as one of the outstanding directional-drilling companies in California. Recently he expanded the firm's operations into Canada.

C. J. PAINE, a director at large, was in charge of entertainment for this year's meeting. In addition, as chairman of the research and education committee, he has been guiding this group's new employer unit plan of supervisory training which was started at Midland last March. A partner and general manager of the 20-year-old F. B. Paine Drilling Co., Dallas, he was one of the founders of the association and was its first secretary.

RALPH W. MARSHALL, who heads the rotary drilling and equipment committee, long has been interested in improving the design and operation of rotary equipment. He particularly places emphasis on use of the right rig for each job; that it be of sufficient size and designed for the job at hand. A vice president of Drilling & Exploration Co., Inc., with headquarters in Los Angeles, he is dividing his time between the California and Dallas offices.

C. W. ALCORN, vice president of Falcon-Seaboard Drilling Co., Houston, this year again headed the important committee of rotary drilling methods. Long experienced in drilling methods and equipment, having started more than 20 years ago in West Texas, he is well qualified to direct the association's activities in this field. He is well acquainted with problems involved in deep drilling since he supervises his company's Gulf Coast operations.

J. E. BRANTLY, president of Drilling & Exploration Co., Inc., Dallas, is chairman of the publications committee, which directs the policy of the bimonthly Drilling Contractor. He was the first president of A.A.O.D.C. A pioneer in rotary contract drilling, he developed the "feed control," high-speed rotation, and other practices which make for more economical drilling. In addition to his talents as an engineer and industrialist, he is the author of Rotary Drilling Handbook, the fifth edition of which is in preparation today. Because of this extensive background he was well suited to head the program committee for the current meeting.

F. W. BRIGANCE, vice president and general manager of Rowan Drilling Co., Inc., Fort Worth, was chairman of the finance committee for this year's annual meeting. Also he is one of the association's directors at large. He has given much attention to methods of moving rigs and to equipment maintenance problems, and has headed or served on many of the group's committees.

ROY GUFFEY, general manager of the Dallas drilling concern bearing his name, headed the publicity committee. Formerly a partner in a derrick-manufacturing company, he specializes in designing his company's own equipment. He also has had marked success in using 4-in., 11-lb. tubing as drill pipe for drilling wells of medium depth.

J. L. RUSH, who with his two brothers operates Trinity Drilling Co., Dallas, had charge of housing for the meeting. A vice president in the drilling company, he is president of the recently formed production company. The contract-drilling company, which was organized in 1923, currently is confining its operations largely to the Permian basin.

THOMAS J. CARTER, a drilling contractor who worked at almost every drilling job before going into business for himself, is chairman of the banquet committee for the Dallas meeting. Now head of the Dallas company bearing his name, he received his early training in Oklahoma City field. He is a member of the dues and membership committees.

DORRIS L. BALLEW, a regional director for the Cretaceous and Tertiary basins, during the past year guided the insurance and safety committee through an especially active year. He is president of Dorris Ballew, Inc., Natchez, Miss., and operates chiefly in Louisiana and Mississippi. An ardent sportsman and former Oklahoma cowboy, he currently is heading an effort to stage a top-flight rodeo in Natchez this fall.

ROY GUFFEY

J. L. RUSH

THOMAS J. CARTER

H. E. HAMILTON, coowner of Morris-Hamilton Drilling Co., Houston, soon will complete his second year as chairman of the committee on taxes. One of the association's early directors, he also has held the office of vice president for the Gulf Coast and is a member of the men and management committee. He has made extensive studies of accounting and insurance problems peculiar to the contracting phase of the industry.

One of the A.A.O.D.C.-sponsored management institutes is shown during an instruction period. A total of six institutes were presented, each lasting a full day

SAFETY
ACCOUNTING METHODS
TRAINING PROGRAMS
COLOR CODES
MANAGEMENT INSTITUTES
DRILLING SCHOOLS
MUD CONTROL COURSES
INSPECTION CHECK SHEETS

A. A. O. D. C. Constantly Broadening Its Sphere Of Activities

D. H. Stormont
District Editor

WHEN the American Association of Oilwell Drilling Contractors held its annual meeting in Dallas this week it culminated the group's most active year since the association was formed in the fall of 1940.

Organized for the basic purpose of advancing drilling standards generally, the association is continually broadening its services and fields of endeavor. The fundamental phases of activity, such as safety, accounting methods, and study of various problems, continue to account for much of the group's effort. In addition the A.A.O.D.C. has undertaken an extensive training program for improving the ability and efficiency of its members' employes as well as that of management itself. Largely through association effort, definite progress also is being made toward standardized contracts.

That the association is truly representative of the United States oilwell drilling industry is shown by the fact its members operate about 1,600 of the some 2,500 available rigs in the country. Its sustaining membership at this time totals approximately 425 drilling contractors and its total membership is around 1,800. Furthermore, the number is constantly increasing as about 100 new members have been added so far this year.

Most pressing problem of the drilling contractor today is one of oversupply—in most oil areas there are too many rigs available for the work at hand. This situation is causing contractors to be even more competitive in bidding for jobs in an effort to keep their rigs busy. Association activities in this field, however, are of necessity entirely educational. It seeks to provide its membership with data and services which will enable the individual contractor to develop a more efficient organization and conduct his operations on sound principles.

The association's most ambitious undertaking to date was its series of "Management Institutes," which was concluded last July. Designed to aid the participating companies in establishing well-rounded, smoothly functioning organizations, the institutes were presented in 15 cities throughout the oil country. Total attendance, all of which was made up of drilling superintendents or personnel of a higher supervisory capacity, was almost 500.

Six different institutes were presented, each lasting a full day or longer. The conferences were: (1) Principles of Top Management Or-

(Continued on page 284)

NEW DEVELOPMENTS in Drilling Equipment and Practices

by Ivan S. Salnikov

IN this annual special issue of The Oil and Gas Journal devoted to "Drilling Contractors and Equipment," a number of important developments in rotary drilling will be discussed. A tabulation of what are considered among the most important of these developments in recent years is as follows:

1. Unitization and portability of drilling rigs and equipment.
2. Better-quality steel for drilling equipment.
3. Improved equipment and machinery design.
4. Improvement of drilling muds.
5. Better understanding of hydraulics in mud systems.
6. Proper application of weight on the bit and rotating speeds.

A discussion of these developments as they stand with us here in 1949 follows for each heading:

Unitization and portability.—Present high operating costs of drilling rigs place a premium on operating speed. Days lost in tearing down, moving, and rigging up are a heavy financial burden. Numerous improvements, designed to reduce the time required to move rigs from one location to another, have been introduced over the past several years. Today we have standardized layouts, unit skids for pumps, boilers, and shale shakers, and standard piping manifolds fitted for quick make-and-break joints and connections. Moving a battery of steam boilers on one skid from one place to another, skidding derricks or moving an entire rig in a few packages saves time—and money. **In fact, savings up to 50 per cent have resulted from well-planned layouts and properly designed and equipped rigs.**

Portability was first developed for small rigs capable of no greater depths than 5,000 ft. Today, however, 10,000-ft. rigs are built so they can be moved, dismantled, or reerected easily.

The author is coordinator of engineering and equipment, producing department, Standard Oil Co. (N. J.). He has had wide experience in drilling and well completion work. Salnikov is a graduate of Colorado School of Mines, 1925. From that time until taking up his present duties in New York City in 1944, he was with Carter Oil Co., successively as petroleum engineer, division engineer, division superintendent, and chief engineer.

Better materials.—While unitization and portability have made drilling more economical, they have not added much to the depths the bits can reach. It took improvements in the quality of steel to do that, for as wells went deeper the high temperatures and pressures encountered at great depths imposed more and more mechanical problems—p r o b l e m s that former steels could not handle.

Let's look at some of these problems. Drill pipe of A.P.I. Grade E 75,000 psi. minimum yield strength is not suitable when drilling to the depths now being attained. For security and safety, drill pipe with a minimum yield strength above 100,000 psi. is necessary.

Fortunately, as a result of wartime research in the United States, such steels become available to our industry. A number of high-yield-strength strings of drill pipe have been manufactured for testing in deep drilling. S.A.E. 4340 nickel-chromium-molybdenum steel is being tried for drill pipe and tool joints in deep-well experiments. Normalized-and-drawn state is being used for drill pipe, and normalized-quenched-drawn form for tool joints.

S.A.E. 4340 steel is also suitable for the manufacture of casing. The yield strength of this steel is 25,000

psi. higher than the N-80 grade, the highest tensile strength steel casing that has hitherto been available. With tubular goods made of S.A.E. 4340 steel, a casing string of 9⅝-in. size can be set at 15,000 ft.; 8⅝-in. strings to 16,000 ft.; and 5½, 6⅝, and 7⅝-in. strings at 20,000 ft. A string of 7-in. casing made of S.A.E. 4340 steel was recently set at 19,765 ft.

Improved equipment.—The trend toward deeper drilling has of course resulted in taller and stronger derricks. The derrick committee of the American Petroleum Institute recently established the following tentative specifications on high derricks for deep drilling:

Height, ft.	189
Water-table opening, ft.	7½
Base square, ft.	37½
Derrick capacity, lb.	900,000 to 1,500,000
Gin-pole capacity, lb.	20,000
Rated actual wind velocity, m.p.h.	100

With such a derrick drill pipe could be racked in either 120-ft. lengths composed of four Range 2 joints, or 130-ft. lengths of three Range 3 joints. If we assume that 5-in. o.d. drill pipe, internal upset and threaded for A.P.I. 4½-in. internal-flush tool joints, is used for drilling to 20,000 ft., the weight of a full length of drill pipe would be approximately 220 tons.

The drill pipe and casing loads at 20,000-ft. depths are too great for the usual 1¼-in. drilling wire lines. For this reason the trend is toward heavier 1⅜ or 1½-in.-diameter wire lines. In fact, 1½-in. line was used for the 20,000-ft. well in Wyoming. Line of this size provides a safety factor of four or better in drill-pipe service, and a safety factor of three or better in casing service.

In power plants there is a trend toward internal-combustion engines, especially in the design of deep-drilling rigs. There was a time when power rigs were handicapped by the lack of large power units, suitable control equipment, and power pumps of sufficient size. Today a variety of units with up to 750-hp. is readily available for outfitting almost any size rig. And, in addition to providing the horsepower required, the new engines are better designed, smaller, and lighter.

In combination with air clutches and hydraulic drives the present power units can be controlled and handled with ease. And, in parallel with these developments, equipment manufacturers have developed large-size power pumps and a means of operating such pumps in multiple assemblies. Power pumps of 700 hydraulic horsepower are now available to the industry. Two such pumps can provide reasonable fluid circulation in the deepest drilling operations.

Wartime expansion of diesel manufacturing has made available to the oil industry a large selection of diesel

(Continued on page 289)

This Business of

CONTRACT DRILLING

The Oil and Gas Journal has just completed a comprehensive questionnaire-survey for drilling contractors operating 1,814 rotary rigs and 486 cable-tool rigs, and additional data have been obtained from the Journal's own statistic-economic department and other recognized sources. This material has been assembled by Kenneth B. Barnes, the Journal's engineering editor, in condensed easy-to-read "question and answer" form, in the following report.

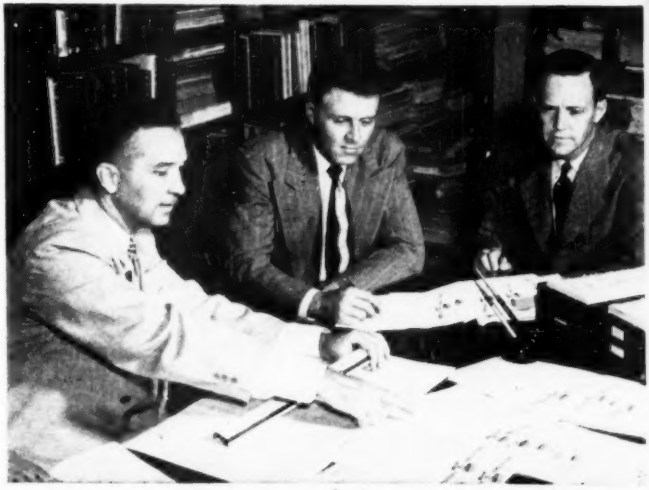
Q.—How much of the total drilling in the United States is done by the drilling contractor?

A.—Drilling contractors are responsible for at least 82 per cent of the footage drilled. This figure was the achievement for 1948, and it may be even somewhat higher this year. The total footage produced by the drilling-contracting industry has gradually increased from 71 per cent of the footage drilled just before World War II.

Q.—What does the above accomplishment by the drilling-contracting industry mean to the nation, in barrels of oil?

A.—Last year an all-time peak was

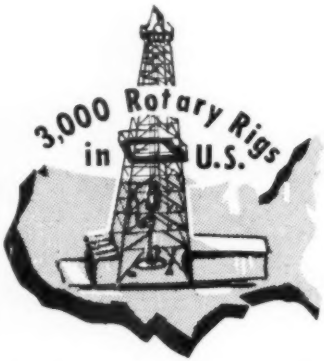
"DRILLING QUESTIONNAIRE" BY THE OIL AND GAS JOURNAL.—Here Barnes discusses drilling contractor and drilling equipment data with Roy F. Carlson, district drilling editor, and Dan B. Miller, equipment editor



reached in crude production—5,688,000 bbl. per day during December. At the same time proved reserves were estimated at nearly 27 billion barrels (total liquid hydrocarbons). Both this enormous production rate, and reserve supply, should be compared with the figures for 10 years ago. Then the estimated reserves were only 17 billion barrels and the production rate was averaging 3,330,000 bbl. per day. In the meantime, during this 10-year period under comparison, more than 16 billion barrels of crude oil were produced.

Q.—What do these barrels-of-crude-oil figures mean in terms of footage drilled?

A.—A realistic idea of what is obtained by drilling a certain number of feet of hole can be gained by the factor "barrels of new oil developed per foot drilled." The results of drilling as expressed by this factor of "barrels per foot" are given in the following table, by years, starting with the last prewar period.



BARRELS NEW OIL PER FOOT DRILLED, TOTAL UNITED STATES

Year	Millions ft. drilled	Millions bbl. new oil	Bbl. per ft.
1941	98.5	1,966	20.0
1942	60.8	1,883	30.9
1943	61.3	1,487	24.3
1944	80.7	2,067	25.6
1945	93.2	2,088	22.4
1946	97.1	2,666	27.4
1947	114.1	2,471	21.7
1948	137.4	3,808	27.7
Total	743.1	18,436	24.8

Q.—Can a dollar-value significance be given to footage drilled?

A.—If we take a round-number average of the above factor as being about 25 bbl. per ft. drilled, and multiply this by an average worth of $2.50 per barrel for the crude oil, the average worth of each foot of hole drilled is approximately $62.50. Of course it takes more than well drilling alone to produce this unit value of $62.50 per foot—it requires the costs of exploration and lease acquirement, well completion, producing equipment and operation, crude-oil gathering expense and many other factors. To proceed, however, to analyze the factor on a total data basis—if about 138,000,000 ft. of hole is being drilled annually, and that is multiplied by the $62.50 value being produced per foot—the money return from the drilling being done in the United States adds up to the astounding total of 8.6 billion dollars annually, based on the value of the crude oil only! When it is remembered that the drilling contractors are responsible for 82 per cent or more of the total footage, the magnitude of the ultimate value obtained from their work certainly defines **this business of contract drilling** as being of major importance in the petroleum industry.

Q.—What is the trend in costs?

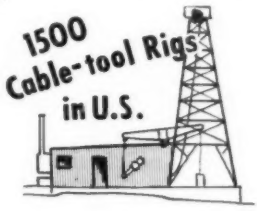
A.—One authority estimates that labor costs are up at least 60 per cent and equipment costs about 50 per cent—since prewar time. The experience of one very large producer indicates that his total cost per foot of hole (Texas, Louisiana, Mississippi) has increased 140 per cent over the 1941 average. Of this the unit costs—material, labor, and transportation—have risen 65 per cent over the 1941 average. Factors contributing to the rest of the big markup in cost per foot, for this instance, besides the foregoing, are greater well depths, hard formations, abnormal pressures, marine operations, multizone reservoirs, etc.

Q.—How many rotary rigs are there, and how busy are they kept?

A.—There are 3,000 rotary rigs in the United States at the present time. During 1949 to date the number of rotary rigs in operation have fluctuated, sometimes slightly over and sometimes under the 2,000 mark. There are a number of reasons why the extra rigs are not at work **(the number of well completions so far this year is slightly above the number for the corresponding period last year—see tabulation under "Exploration Data" in the statistical section of this issue; also, in the 6-month period, January-June 1949, 67,172,000 ft. of hole was drilled as compared with 61,571,000 ft. in the same interval of last year).**

One of the most important reasons for the current dropoff to the 2,000-plus-or-minus mark in rotary rigs running this year versus the 2,160 average last year is that the drilling industry this year is drilling faster and more efficiently. More footage is being drilled with fewer rigs.

(An article discussing "More Footage Drilled With Fewer Rigs" will be found on page 179 of this issue.) On the subject of why today's modern drilling rigs make faster hole, and are more efficient in terms of performance, a discussion is given in the article immediately preceding this one.



Q.—What has the drilling industry done to bring about this improved efficiency?

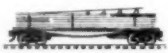
A.—Market-research data show that in the past 4-year period 1,900 new rigs have been bought. During the same period approximately 1,100 old rigs have been retired.

Q.—What does the drilling contracting industry have invested in equipment?

A.—Investment in rotary rigs by drilling contractors now totals 250 million dollars.

Q.—What is the rig picture, from the standpoint of drilling-contractor ownership?

A.—Of the total rotary rigs in this country, drilling contractors own about 2,000. Last year contractors were operating a total of 1,800 rotary rigs. A.A.O.D.C. members are at work in virtually every major drilling area in the world at present, with the exception of the U.S.S.R.



Journal Drilling Survey Learned the Following Facts From Its

... POLL OF ROTARY RIGS ...

... POLL OF CABLE-TOOL RIGS

This present Journal survey affords an interesting comparison with one made by the Journal 10 years ago:

Steam rigs	**58%**
Mechanical rigs	**37%**
Electric rigs	**5%**

And percentage of portable cable-tool rigs was vastly less.

This reveals dominant trend towards increased portability and reduction of high fuel and water requirements in drilling equipment.

Q.—What are the figures for cable tools?

A.—Cable-tool rigs capable of drilling to creditable depths are estimated to total 1,500 in the United States at present.

Q.—What type of rotary rigs are being used by the drilling contractors?

A.—The Oil and Gas Journal questionnaire, for which replies were received for 1,814 rigs, shows that 80 per cent are mechanical, 16 per cent are steam, 4 per cent are electric.

Q.—What type of cable tool rigs are being used by drilling contractors?

A.—The Journal's questionnaire revealed that 35 per cent are standard rigs, while 65 per cent are in the portable design category.

Q.—What type of prime movers are being used?

A.—The Journal's questionnaire obtained this breakdown on the basis of gas-gasoline, diesel, diesel-generated electric, purchased electric, and steam, both on a percentage basis and as to number of rigs (see accompanying chart). The figures by number of rigs are presented on the basis of 3,000 total.

Q.—What type of prime movers are now used on the standard rigs?

A.—Eighty-six per cent are power operated, and 14 per cent are steam operated.

Q.—What percentage of the drilling contracting industry now also owns oil and gas production?

A.—The Journal survey showed that the proportion of contractors owning production varies from 73.4 to 80.8 per cent. A breakdown, based on rig ownership, is given in the accompanying chart.

CONTRACTORS ALSO DRILL FOR THEMSELVES...

. . . . **In polling the entire drilling contracting industry, The Oil and Gas Journal asked this question, *"In addition to your contracting business do you own an interest in oil and gas properties?"***

The Replies:

	% Owning Production
Contractors owning less than 3 rigs:	73.4%
" " 3 to 5 rigs:	76.1%
" " 6 or more rigs:	80.8%

by Hamilton Rogers

the Drilling Contract

Hamilton Rogers has been associated with Rowan Drilling Co. since 1941. He was born in Dilley, Tex., attended public schools and was graduated from the University of Texas in 1938. This article is a portion of a paper presented at the A.A.O.D.C. meeting at Dallas.

WHILE progress in the discovery and development of oil resources of the world has stemmed, to an appreciable extent, from the independent contractual relationship between the companies and drilling contractors, the contracts defining that relationship have not kept pace with progress in the industry and have not evolved to reflect new and changing techniques, conditions, hazards, and methods of operation. Some of the provisions in drilling contracts today refer to practices and procedures long since obsolete and have no place in a contract relating to modern power-rig operation. . . .

Company and Contractor

To be sure, everything is more complicated now, and besides that, companies have had bad experiences with a lot of the rugged individualists who followed the rigs, kept books in their hippockets, and slept near the boilers. These bad experiences led to complicated contracts, piecemealed from time to time with pocket additions designed to avoid a recurrence of the most recent experience, to the end that we now have patch-worked contracts, one sided in design, which do not reflect the ordinary, basic understanding between men who have grown with the industry. . . .

If I were asked to define a drilling contract, I might truthfully say that a drilling contract is that practical, though unenforceable, working agreement between the operating executive and the contractor which embodies the time-tested customs and the ordinary practices and procedures which have evolved during years of cooperative work and effort. But those customs and practices, particularly in reference to risks and responsibilities, are not always reflected in the printed agreements which contractors sign. . . . The printed contracts simply do not reflect executive thinking. After all of these years of cooperative work, it seems that the basic, ordinary understanding between the operating executives and the contractors has not yet cleared the legal department. . . .

Companies and contractors would mutually benefit if a uniform drilling contract were used which completely, accurately, and fairly specified the rights, duties, risks, and obligations of the respective parties. This is a long-range objective, difficult to achieve which will require time and patience and practical knowledge and understanding. . . . For the time being, it is urged that each company review its drilling contract and have it rewritten to express fairly those practical understandings which have evolved through years of experience and have become the actual practices and customs in the industry. The specific language utilized is unimportant if basic principles are fairly expressed and the actualities of modern operations kept in mind.

Contract Considerations

Day work.—Consider, for example, the concept of "day work." In coring, drill-stem testing, electrical logging, and other instances where work is normally performed on a day-rate basis, the company has the right of control. If a packer fails on a drill-stem test, the pipe is stuck, and the hole junked—who has the risk? Most of the printed contracts raise considerable doubt, or at best, the answer is in the "unsaid" section of the contract.

Some of the contracts say that day work has no meaning or significance other than to designate the manner of payment, although court decisions seems to imply a significance of considerable importance. In spite of the "unsaid" section or the specific contractual definition, practical operating men say that by custom and practice the company takes the risk of the hole and the equipment in the hole while working on day work. If this is the practice—if this is the custom—would it be unfair to incorporate this principle in the printed contract?

Abnormal hazards. — Suppose the contractor encountered granite, high-pressure water flow, heaving shale, or other abnormal drilling hazard before the specified depth is reached —who has the risk? Many of the printed contracts omit entirely any reference to abnormal hazards, and presumably the contractor would be required to drill through solid granite or fight heaving shale to the specified depth (and incidently tender the hole in acceptable condition) in order to earn his pay.

Other contracts contain protection clauses which require the contractor to control high-pressure water flow or similar hazards for a specified number of hours before day work begins but leave in the unsaid section the question of risk during the fight. Yet, when these conditions are encountered, practical operating men say that by custom and practice the contract is deemed complete, and all additional work is performed on day work at the risk and responsibility of the company. If this is the practice —if this is the custom—would it be unfair to incorporate this principle in the printed contract?

Hold-harmless clause. — Take the "hold - harmless" clause in most of these contracts — now that is the clincher! Although the contractor may have no direct liability, he contractually agrees to be liable and to protect, indemnify, and hold the company harmless "from and against all claims, demands, and causes of action of every kind and character arising in favor of third persons on account of personal injuries and/or death or damage to property occurring, in anywise incident to, or arising out of the work performed by contractor, and particularly, but not by way of limitation, against any loss or damage whatsover caused by fire, blowout, explosion, or accidents of any kind during the drilling and until the completion of the well and the acceptance thereof . . . and agrees to pay company for destruction of

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FAST DRILLING RATE

Set by turbine method . . . Drills 2,006 ft. in 26 hours, 10 minutes at a well in Coastal Louisiana

by D. H. Stormont
District Editor

On last August 16 at 12:10 a.m. an Edco Turbodrill started cutting a 13-in. hole at 1,242 ft. in Golden Meadow field of Gulf Coast Louisiana. When the drill was pulled from the hole at 2:20 a.m. on August 17, the bottom of the hole was at 3,248 ft. The bit had cut 2,006 ft. in a total elapsed time of 26 hours and 10 minutes, or at the average elapsed time rate of 77 ft. per hour. This performance, if not the fastest, certainly ranks among the highest penetration rates ever achieved in Gulf Coast drilling.

IN drilling the upper sections of Gulf Coast wells, such as was performed at Golden Meadow, making 1,000 ft. of hole per day is considered excellent time with rotary equipment. Using such equipment, one well in St. Landry Parish, Louisiana, earlier this year drilled to 5,000 ft. in a net drilling time of 4 days, or at the rate of 1,250 ft. per day. This was believed to be a record rotary drilling rate for the area.

The drilling operation at Golden Meadow, where an over-all net drilling rate of 120 ft. per hour was attained, showed the turbine drill to have an indicated capacity of 2,500 ft. per day in these upper formations (1,296 ft. in first 12 hours). And this penetration rate was achieved while drilling at only 40 per cent capacity and the rig being operated by drillers who had no previous experience with the turbine method.

The run was carried out by Engineering Development Co., developers of the Edco Turbodrill, and Spartan Drilling Co. at the latter's 7 B. & D. Cheramie in La Fourche Parish. Surface hole had been drilled with conventional rotary to 1,187 ft. where 16-in. surface pipe was set. Rotary also was used to drill out the plug and to 1,242 ft. with a 13-in. bit. At this point turbine drilling was commenced.

The operation was the third field test for the turbine drill. Initial tests were conducted in May 1948 at a wildcat in Union County, Arkansas.* In this test 950 ft. of formation, consisting of sand, sandy shale, shale, boulders, and hard lime streaks, were cut in a total elapsed time of 17 hours and 53 minutes. A 13¾-in. bit was used and the drill string consisted of 4½-in. drill pipe except for two joints of 5 9/16-in. pipe immediately above the turbine.

On this initial test an over-all drilling rate of 1.75 ft. per minute while on bottom (950 ft. in 541.5 minutes) was attained. Maximum penetration rate for one joint of drill pipe was 6.2 ft. per minute. The last 124 ft. were drilled with a seriously underpowered turbine as the one mud pump was unable to deliver the required fluid power at that depth through the 4½-in. pipe. Thus, except for that length of hole, the over-all rate of drilling was 2.3 ft. per minute (826 ft. in 359 minutes).

A second test was conducted in the Bradley area of Southern Arkansas, at which the turbine drill was used to cut a 20-in. surface hole.† At this test it developed that attachments on the tool to provide protection against large solids entering and blocking the fluid courses were necessary. These protective devices were developed and are now standard attachments for use with the tool when drilling formations made up of gravel and pebbles.

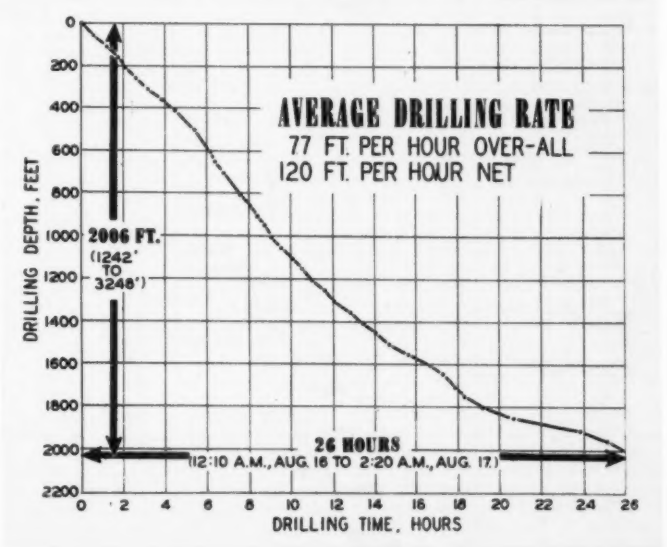
The 10¼-in. o.d. turbine drill used in these operations is designed to deliver 312 hp. to the bit at the full-rated fluid input of 900 g.p.m. It consists of a 90-stage, axial-flow hydraulic turbine driving the bit directly without use of reduction gears. The drilling tool is made up on the bottom of a conventional string of drill pipe and utilizes drilling-fluid pressure to rotate the conventional rock bit attached directly to the bottom sub. Weight of the tool, which measures 30 ft. in length, is 8,000 lb. with the subs added.

As stated earlier, at No. 7 Cheramie the Turbodrill cut a 13-in. hole

*See "Turbine Drill Utilizes Drilling Fluid to Rotate Conventional Rock Bit," by George Weber, The Oil and Gas Journal, June 3, 1948, p. 58.

†Critchell Parsons, World Oil, July 1, 1949, p. 87.

Fig. 1—This drilling-rate chart was taken from a Geolograph log made during drilling at the well. It includes some downtime for cleaning shakers



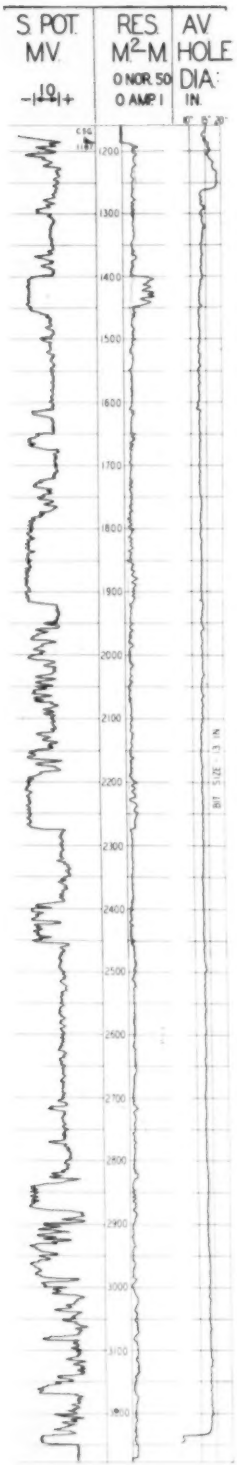
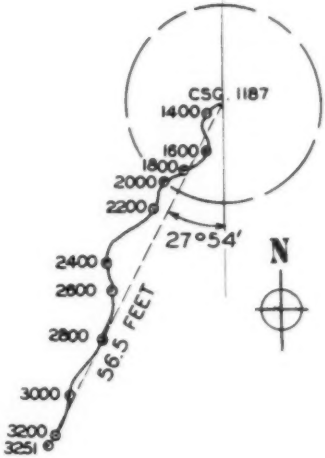


Fig. 2—(Left) Electric and caliper logs of the Turbodrilled hole. The hole was drilled with a 13-in. bit on a string of 4½-in. drill pipe. Average annular mud velocity was 108 ft. per minute. Fig. 3—(below) Photoclinometer survey of the Turbodrilled section was 3°. The bottom of the Turbodrilled hole lies 56 ft. from the bottom of the surface casing point



from 1,242 to 3,248 ft. in a total elapsed time of 26 hours and 10 minutes. This time was distributed as follows: Making drill-pipe connections, 427 minutes; circulating after kelly was down, 120 minutes; down time while cleaning shale shaker, 20 minutes; and on the bottom drilling, 1,003 minutes. No trips were made during the run to change the bit or for any other reason.

An analysis of the elapsed-time penetration rates and of the penetration rates while on the bottom drilling are given in Table 1. The overall elapsed-time penetration rate, which includes down time, circulation and connection time, and drilling time, was 77 ft. per hour. In the fastest 1-hour period 167 ft. were cut. During the last 9 hours, due partially to a leak around the drive-shaft sleeve bearing, the elapsed-time penetration rate fell off to an average of 40 ft. per hour.

Study of the data on actual net drilling time in Table 1, as well as the drilling-rate log shown in Fig. 1, shows that the fastest time for a single 30-ft. joint was 2.5 minutes, or at a drilling rate of 720 ft. per hour. For 17 consecutive joints a drilling rate of 266 ft. per hour was achieved, and for the entire 2,006-ft. section the penetration rate was 120 ft. per hour.

The section penetrated from 1,242 ft. to total depth of 3,248 ft. was alternate sand, sticky and medium shale.

TABLE 1—TURBODRILL PENETRATION RATES AT NO. 7 CHERAMIE

A. While on the Bottom Drilling

	Footage	Drilling time, min.	Rate in ft. hr.
Fastest joint	30	2.5	720
Fastest four consecutive joints	122	12.0	610
Seventeen consecutive joints	527	119.0	266
Over-all	2,006	1,003.0	120

B. Elapsed Time Penetration Rates

	Footage	Rate in ft. min.	Rate in ft. hr.
Fastest hour	167	2.78	167
Fastest two consecutive hours	310	2.59	155
Fastest four consecutive hours	550	2.29	137.5
First 12 consecutive hours	1,296	1.80	108
Last nine hours	360	0.68	40
Over-all (26 hours, 10 min.)	2,006	1.28	77

with thin sections of the hard crystalline formations usually found above the deep salt dome at Golden Meadow. The crystalline formation at 2,830 ft., where the rotary frequently twists off the drill pipe, was penetrated without vibration or other difficulty at the rate of 1.5 ft. per minute. The electrical log of the section cut by the Turbodrill is shown in Fig. 2.

The aforegoing paragraphs show the Turbodrilling rate achieved at No. 7 Cheramie. It naturally follows that a comparison of this performance with

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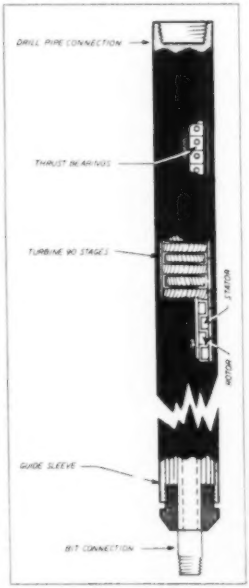
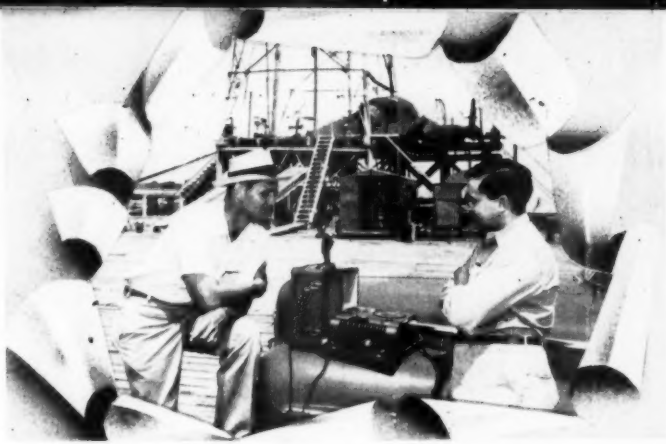
Fig. 4—(Left, below) Sectionalized drawing of the Turbodrill. The turbine measures 10¼-in. outside diameter, is 30 ft. long, and weighs 8,000 lb. It will deliver 312 hp. at a fluid-input rate of 900 g.p.m. Fig. 5—(Right, below) Photograph of the turbine on location, being hoisted to the derrick floor





Novel Technique Speeds Journal Article

This article brings a new method of technical reporting to the readers of The Oil and Gas Journal. In the accompanying photo, Leigh S. McCaslin, Jr., Gulf Coast editor for the Journal, has a new type portable wire recorder "on the spot" for a fact-by-fact discussion with A. P. Robishaw, drilling engineer, Housh Drilling Co., Houston.

The wire recorder interview subsequently was transcribed into a typewritten report, and that report is reproduced here.

Pay$ Dividend$

Q.—(By Leigh S. McCaslin, Jr., The Oil and Gas Journal)—What is this well location that your newly unitized rig is on?

A.—(By A. P. Robishaw, Housh Drilling Co.)—This is the Stanolind Oil & Gas Co. 1 Flint Unit, a semi-wildcat near North Houston field. The rig is our No. 3.

Q.—What is the purpose of the changes you have made on your rig since its last location?

A.—We are trying to unitize all of our rigs just exactly alike. We want to be able to interchange any part of a rig, at any time, with the least amount of unnecessary labor. We want to reduce our handling and hauling costs, keep all our miscellaneous lines as straight as possible, and make the rig as simple as possible.

Q.—What were some of the general considerations in redesigning your rig layout?

A.—We went at it from an engineering standpoint—got accurate measurements on everything and put all dimensions and hookups down on paper. We thus now have a complete set of drawings on the rig and can order or send out replacements by looking at these drawings.

In doing the work, we looked at it from every standpoint—the tool pusher, the roughneck, the truck driver—and tried to fix things so they couldn't go wrong. We wanted to run every leadoff possible at 90°. That is why the derrick, pipe racks, and the boilers are all on one line. It was desired to make the setting on all of our rigs the same—where the boilers sit, where the pits are located, and so on. We wanted to make all pump hookups as nearly alike as possible, regardless of size or manufacture. As for piping, our purpose was to manifold it into a portable unit wherever possible.

Q.—How many rigs have you unitized under this new setup?

A.—This is the first, but we have equipment and parts on hand to unitize three more.

Q.—How much time and money do you figure your unitized rig will save you over the old setup?

A.—Our rig-up time has been cut 50 per cent. However, we have actually saved more than the cost of rig time. Such things as wear and tear on valves, pusher's time in running down odds and ends, truck time to move the units, and a number of intangibles enter into the picture. Over-all, we ought to save around $1,500 per location. We now have more equipment rigged up quickly than before, because we used to wait until actual drilling was under way to hook up items not needed for spudding in. Under the new setup, however, everything is in place and ready to go after the initial rigging up period.

Q.—How will this unitized rig help you from a competitive standpoint?

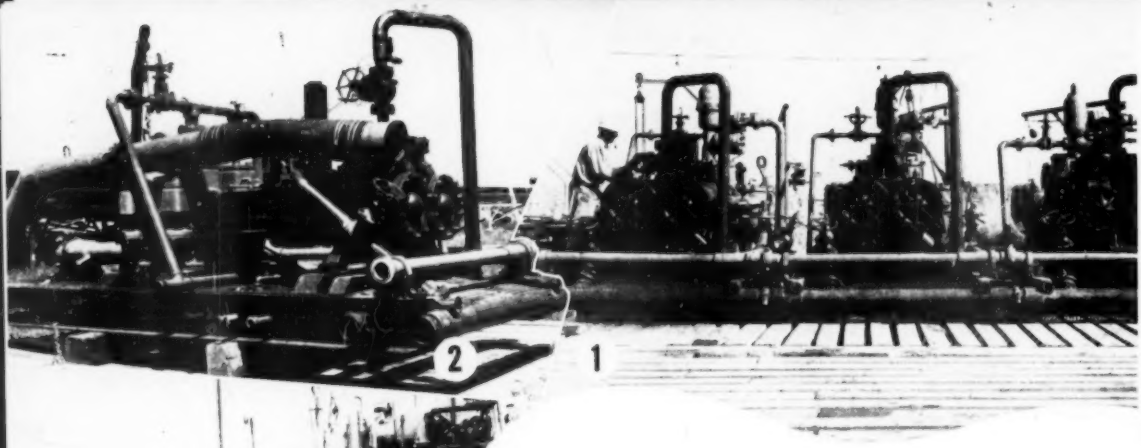
A.—Oftentimes it is necessary to shift the equipment on a rig around in order to do a certain job. In contracting you can't get together a certain type of rig and leave it intact for all jobs. Perhaps on a certain well you can't move all of one big rig to the location and still bid competitively with some other contractor. However, you have a smaller rig close by so you just bring a larger pump, or whatever is needed, from the distant rig and tie it into your smaller rig. A unitized rig setup makes this possible.

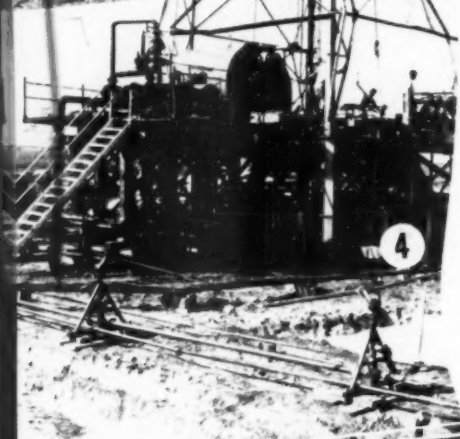
Q.—I notice your three slush pumps appear to be highly unitized—what special measures have you taken with them?

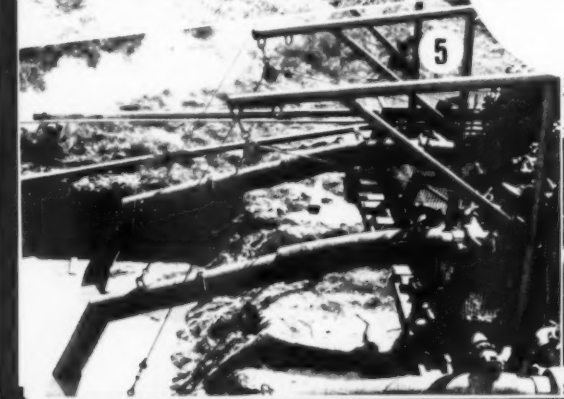
A.—(See photos 1 and 2). When we built our pump skids we started at the bottom and worked up as high as we could with everything standard—the spacing of the unions, the kind of unions, the length of the pipe. Our idea was to be able at any time to change pumps. Even if it was necessary to put a different type of pump for a replacement, we wanted to change the minimum number of connections. A study was made of all pumps manufactured so that we could take care of any possibility of size or type of pump. The rigidity of the unit was eliminated as much as possible by using misaligning unions.

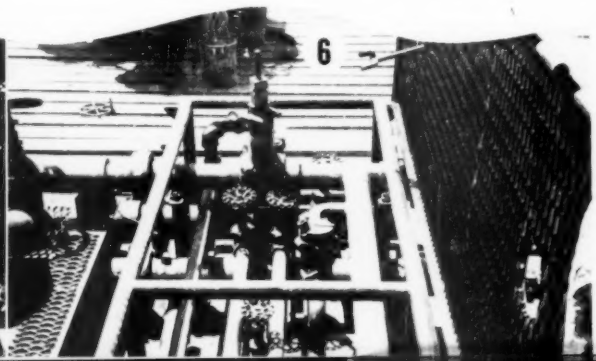
Q.—What steps have you taken to speed up erection of your mud lines, water lines, etc.?

A.—(See photo 3). All piping has been manifolded into portable units which can be handled easily by a truck and a gin pole. Everything possible has been run at 90°. In these manifolded units, valves, swings, and unions are protected. Each unit is balanced and hooks welded at the









point of balance for easy handling by truck and gin pole.

Water traps on the steam lines have been built right into the manifold units. The steel walkway has been put on top of the unitized lines to provide safe and dry access to the important parts of the rig. Electric line poles of 1¼-in. pipe fit into short 1½-in. nipples welded onto the side of the units.

Q.—What special hookup have you used on your mud guns?

A.—(See photo 4). There is a valve at each mud gun to control the flow of mud, as is standard on all rigs. However, there is also a shutoff valve built into the unitized piping manifolds on both the derrick and boiler sides of the pumps. In this way, the guns can be shut off at the manifold without running out to the pits. The guns can be tied into either the derrick or boiler-side manifold thus giving a choice of location.

Lines leading to the guns are made in standard 8 and 16-ft. sections. Hence, the guns can be placed any desired distance from the pumps, within an 8-ft. limit.

1—Three unitized slush pumps, all connections via unions
2—Side view of single unitized pump. Note unions
3—Piping manifold into portable units; walkway above
4—Mud-gun lines are in standardized sections
5—Slush pump booms speed hookup and use
6—Special derrick-slide manifold is multiutility setup

Q.—How do the booms on the suction end of your slush pumps work?

A.—(See photo 5). The booms support a wire cable which is operated by a hand winch. With a cable we can raise and lower the pump suctions in the mud pit. We also have a hook at the point of balance of the suction line. After the union is broken, the winch line can be put in this hook and the suction picked up and loaded on the pump for movement to the next location.

When steel mud tanks are used, the suction line can be broken at the union, the 45° elbow section removed and the remaining portions of the suctions connected by the same union to the mud tank manifolds, without alteration of the manifold or suction.

Q.—What lines do you have in your derrick-side manifold?

A.—(See photo 6). Our 4-in. main mud line from the pumps to the standpipe is the major line in this unit. Tied to it is a 4-in. bypass line which runs to the compounding line at the fluid end of the pumps. By closing one valve and opening another we can bypass around the main mud line, making repairs and replacements possible.

Also in this manifold are a blowout-preventer water line, general-purpose water line, and dry-steam line. Connections for the cementing service company are also in this unit. Valves

for controlling these various lines are built right into the manifold. The expanded metal decking, which protects the unit and also forms a walkway, folds right down on top. The valves are controlled through the decking by means of prongs, making the valves accessible when the decking is down.

Q.—How have you standardized the exhaust line from your engine?

A.—(See photo 7). The exhaust line is made up into standard sections. Incidentally, we're experimenting right now with a check valve on our engine exhaust. The exhaust line ties into a line at the fluid end of the pumps—this line does double duty by serving as a part of the pump skid as well as an exhaust line.

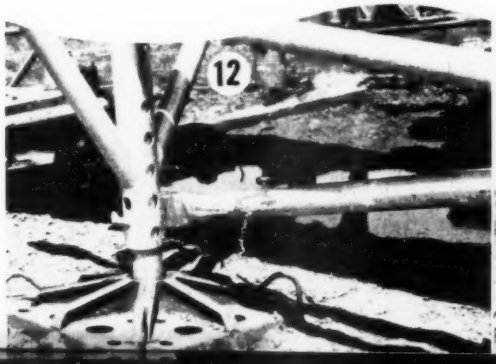
An interesting feature of this exhaust-line hookup is the fact that it can be used either on a 14 or a 17-ft. substructure. This is done with a piece of L-shaped piping between two couplings. By putting the long end of the "L" vertical instead of horizontal, the line fits the higher substructure. In this way, our piping hookup works for both size substructures without any cutting, welding, or additional pipe. This same system has been followed on all lines between the pumps and the rig floor.

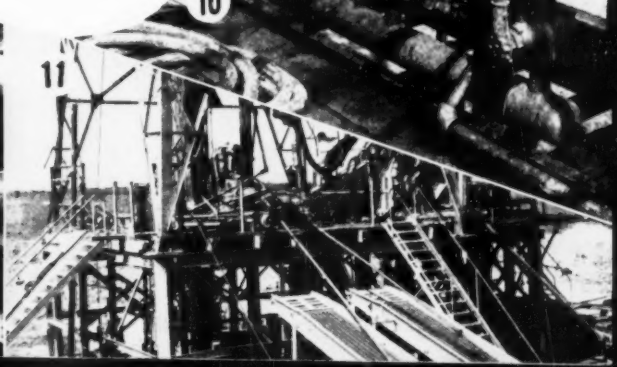
Q.—Would you please explain the engine substructure—it looks different from the usual arrangement?

A.—(See photos 8 and 9). Like most drilling contractors, we have had trouble with vibrations on steam rigs. This substructure is an attempt to eliminate excessive vibration. We have tried to move the pivot point of the load as near the center of the hole as possible. We have built a separate skid out of three 8-by-8 wide-flange beams that run up under the two 12-by-12 substructure sills. There are eyes in these beams so turnbuckles and tie rod can be hooked on at the draw-works end. These run right up to the draw works and pull the 8-by-8 beams right up against the substructure sills. At the other end, the engine skid is tied into the substructure rigidly by means of turnbuckles and tie rods. With these arrangements we have taken out the up-and-down motion of the engine substructure.

The next step was to transfer any vibrations away from the derrick and into the ground. To do this a stiff screw brace has been run from the top of the engine substructure to the 12-by-12 sills that hold the rotary substructure.

7—Exhaust line fits high or low substructure
8—Separate skid run under substructure sills
9—Engine skid tightly tied to substructure via tie rods
10—Blowout preventer manifold is skid mounted
11—Steel loading ramp is safer, stronger, readily portable
12—Pipe rack and legs are adjustable: all steel





Q.—I notice that your blowout-preventer manifold is skid mounted.

A.—(See photo 10). Yes, this is another part of our unitized hookup. The blowout-preventer controls, flowline master valves, and ram controls are built into this unit. There is also piping in place for Hydril connections. The wash-down hose is another part of this manifold. We have built a small chamber at the bottom of the skid where we can mix dry steam with water to get any temperature water we want.

Q.—What's the story behind the unusual-looking loading ramp I see?

A.—(See photo 11). The loading ramp is made out of army treadway bridge parts which we bought as war surplus. We have started using this type of steel loading ramp because of the hazards of wooden ramps. In some areas where we have been on location for 8 to 12 months, the old wooden ramps have actually rotted out.

Our new steel ramp has four curbs so that trucks can't run off. Also, the steel grillage gives good traction. In order to make the ramp transportable on the highways, without getting special permits, it is designed to collapse. The braces pin together—bolts have been eliminated in every case. The ramp is designed for use with either a 14 or 17-ft. suostructure by adding or taking off a section. Steel base plates are used in place of wooden matting.

Q.—Your pipe racks look highly portable—were they designed by your company?

A.—(See photo 12). Yes, we manufacture those racks and have 100 per cent salvage with them. There is no wooden matting used and we have to do very little ground clearing to set them up. The base plate can be set at various angles and the column will still be upright, regardless of terrain. On our first job, five men set up 84 ft. of rack, with catwalk, in 1½ hours.

The upright member fitting into the base plate socket is of 3½-in. drill pipe that telescopes inside a piece of 4½-in. pipe. Holes have been drilled in the 3½ and 4½-in. pipe so that we can get a ½-in. vertical adjustment at any point. On top of the 4½-in. pipe is a 5½-in. saddle braced by 2½-in. pipe.

Sway braces that run from the bottom of one rack to the top of the next one are made of 2½-in. pipe. The braces are tied into the uprights by pins made of 1-in. rod. To support the pipe, 16-ft. sections of 4½-in. heavy-duty drill pipe are laid in the saddles and pinned in place.

Q.—What is the significance of the various colors the rig is painted?

A.—Our company color is orange so much of the equipment is painted this color. In addition, the main mud line is colored orange. Low-pressure mud lines—such as the mud-mixing lines—are colored green. The general-purpose water line has been painted blue, and the blowout-preventer lines are red. We plan to follow this color scheme on all our rigs.

Housh Drilling Co., Houston

LESTER G. HOUSH *C. N. HOUSH*

THIS concern is a "brother partnership" owned by C. N. and Lester G. Housh. Following C. N. Housh's graduation from Leland Stanford University in 1922 as a petroleum geologist, he spent considerable time with the California Highway Commission, Amerada Petroleum Corp., and Gulf Oil Corp. His work took him to most of the Mid-Continent oil states.

The present drilling business was started in 1936 with C. N. Housh, E. G. Thompson and Aubrey Scofield, all former Gulf Oil employes. A few years later Scofield returned to Gulf and Thompson sold his interest to Lester G. Housh, who has been working with his brother in the oil business for several years.

Rigs.—The Housh company operates eight rigs, as follows:

2—Drilling capacity to	15,000 ft.
2—Drilling capacity to	12,000 ft.
1—Drilling capacity to	10,000 ft.
1—Drilling capacity to	8,000 ft.
2—Drilling capacity to	6,000 ft.

(The last three rigs have been assembled to use as combination workover and well-drilling rigs.)

Other activities.—Housh also operates a complete lease maintenance and operation service; a professional geological service; an oil-field appraisal service and a material-rental service. The material-rental service includes, among other things, one Cardwell unit for use on tubing jobs, one Cardwell unit for use as a swab unit, draglines, bulldozers, dump trucks, road maintainers, and other equipment.

Personnel.—The company operates principally in the Gulf Coast area, and its key personnel includes the following: Office: Truman Branton, O'Grady Fair, E. S. Walling, W. T. Westergard, A. P. Robishaw, Norman Mansfield, Paul Shenk, Jr., Etta P. Taylor. Field: D. L. Myers, J. H. Parrish, M. M. Heathman, F. E. Bear, O. R. Dean, E. E. Stevens, W. E. Gucker, L. G. Clark. Majority of the key personnel have been with the company for over 10 years. The company has just recently occupied its new quarters which comprise the entire fifth floor of the new Gulf Building addition.

New plant.—One of the most interesting projects of the company is its completely equipped, modern plant known as "Housh-Fairbanks Plant," which was finished this year and is located near Houston on the Burlington-Rock Island Railroad in the southeast portion of Fairbanks oil field. This plant is designed to maintain and repair all of the company's equipment. Because of the completeness of this plant, and in an effort to fully utilize its facilities as well as provide steady employment for drilling personnel during slack periods, the company has embarked on an oil-field specialty-manufacturing program which promises to assume major proportions.

65 Rigs on proved locations

10 Rigs on exploratory tests

by D. H. Stormont
District Editor

Current Status of

SCURRY COUNTY DRILLING

Most active area in the United States — West Texas' most important development since Yates

DRILLING in Scurry County, Texas, limestone reef fields, which may prove to be the most important development in West Texas since Yates field was discovered more than 20 years ago, today is the most active of any area in the United States. Some 65 rigs are working on proved locations while an additional 10 rigs are attempting to extend productive limits of known fields or uncover additional pools.

This activity is concentrated within a 220-sq. mile area near the booming town of Snyder in the western portion of Scurry County. Its prime objectives are Canyon limestone-reef pays topped at depths between 6,200 and 6,800 ft. Five reef fields have been discovered along an 18-mile northeast-southwest trend; North Snyder, Kelly, Schattel, Diamond-M, and Sharon Ridge (Canyon) fields.

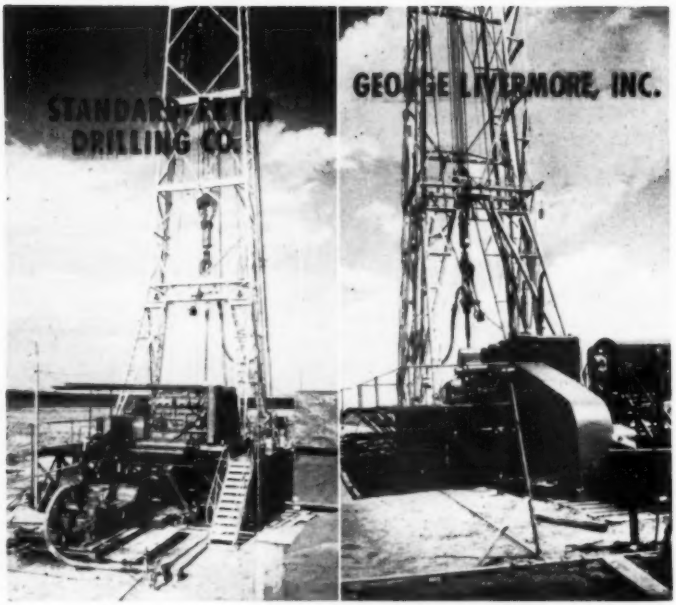
North Snyder field, by far the most important of the five, has a producing section of around 700 ft. in some wells and has a semiproven area of about 10,000 acres. The Kelly area, based on present development, is a low, relatively flat reef buildup with some 125 ft. of pay above water level. Some 4,500 acres are more or less proven by its scattered producers. Schattel field appears to be more or less a pinnacle and of little consequence. At Diamond-M and Sharon Ridge (Canyon), which are expected to develop into a common reservoir, same 300 ft. of reef pay has been cut by a few oil producers. These two fields extend over a semiproven area of around 4,000 acres.

Considerably more drilling will be required before the areal extent of these fields (except Schattel) can be definitely determined. At this time it appears that some 400 additional wells will be needed to develop acreage classed as proven or semiproven. It is almost impossible to foresee what will happen in reef fields; several hundred feet of relief may be lost in just one location's distance. Thus fewer wells may be required or substantially more than 400 added wells may be needed.

Although this prolific reef production was discovered in November of last year, development was comparatively slow until just a few months ago. By July of this year only 34 oil producers had been drilled in these fields and fewer than 40 rigs were at work. In the 2½ months since then, however, activity has greatly accelerated and probably will continue to do so for the remainder of the year. As of September 1 there were some 80 oil producers in the reef fields, as follows: North Snyder, 55; Kelly, 10; Diamond-M, 17; Sharon Ridge (Canyon), 7; and Schattel, 1. Drilling rigs at that time were: In North Snyder, 40; Kelly, 6; Diamond-M, 10; and Sharon Ridge, 5 rigs. In addition there were the 10 wildcats or possible extensioners mentioned earlier.

This stepped-up drilling program is due primarily to the large number

BOB HOPE SAYS CALIFORNIA CAN HAVE ITS ORANGE JUICE!—He's now in the oil business, along with his partner Bing Crosby, at this new Scurry County oil well. At left is his manager, Dick Gibson, with coowners "Tex" and W. A. (Bill) Moncrief of Fort Worth at right



Left: Standard-Fryer rig at work on company's own 1 E. S. Wilkerson, a very closely watched wildcat between Kelly and North Snyder fields. Right: Medium-duty rig of George Livermore at this contractor's own 1 J. E. Woodson, northernmost well in the Kelly area

of leases involved. Also, and in marked contrast to most West Texas oil fields, most of the acreage is held by a great number of independents or small "major" companies. Thus as development spreads, more and more forced offsets are required.

Standard Oil Co. of Texas, with a large block in North Snyder field, holds by far the greatest amount of proven or semiproven acreage. Each section of its holdings, however, is divided into two 320-acre leases which contain offset obligations. Magnolia Petroleum Co. has substantial holdings in the Kelly area but they are not solid and involve a large number of fee owners.

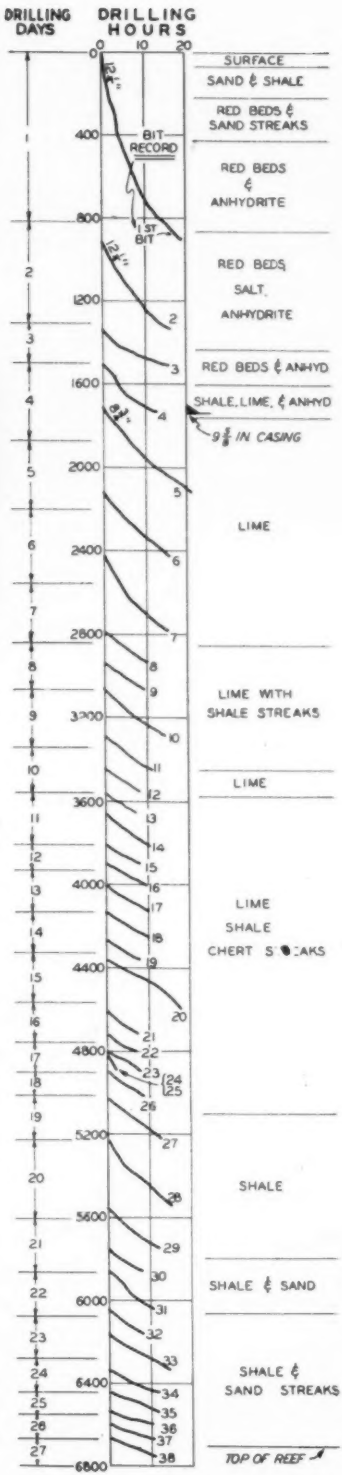
Other factors which make for rapid development are the comparatively shallow depth of the reef pays and the huge pay sections involved. Most pre-Permian pools now undergoing development in the Permian basin require drilling to depths of 8,000 or 11,000 ft.; in Scurry, less than 7,000 ft. is needed. Because of the unusually large producing sections and the anticipated high (for limestone pays) yield per acre-foot, these fields are especially attractive. Most producers are being completed for high initial potentials, flowing at the rate of about 1,200 bbl. daily through ½-in. chokes without acidization.

In the matter of reserves and yields per acre, much more drilling and core-analysis work will be required before their true worth can be accurately established. Also, it must be determined whether the fields have a good water drive, as some engineers anticipate, or if they are only solution-gas drive. Some informed geologists and reservoir engineers do not hesitate to state recoveries will average in the vicinity of 250 to 400 bbl. per acre-foot; those more pessimistic say they will be closer to 100 bbl. *(See The Oil and Gas Journal, July 7, 1949, page 54).* Thus the new reef fields are credited with oil reserves of about 200,000,000 bbl. on the low side, and around 1,000,000,000 bbl. by the more optimistic.

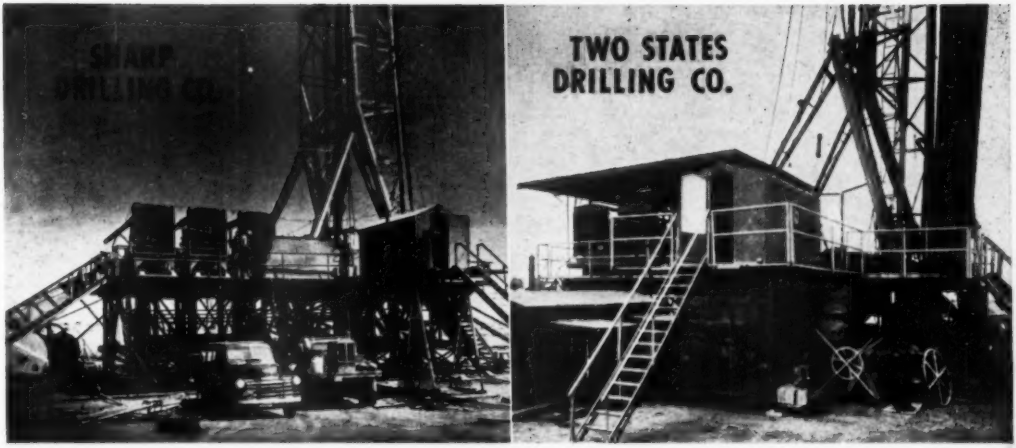
This, in summary, is the picture of drilling activity and general status of Scurry County's reef fields. Within the past few weeks major extensions were given Kelly, North Snyder, and Sharon Ridge fields and several tests which will add much to the knowledge of their areal extent currently are under way. These developments, however, will not be taken up until after a discussion of the equipment being used and drilling practices being followed.

Drilling Practices and Equipment

Drilling equipment being employed is a decided change from the rigs which were used in developing West Texas' major prewar fields. In Wasson, Slaughter, and the Ector County fields, nearly all drilling was done with standard derricks. Generally about one-half of the rigs were steam



Drilling-time progress chart and type log of formations drilled in the Kelly area of Scurry County



Left: This rig, the heaviest in North Snyder field, is owned by Sharp Drilling Co. When photographed it was rigging up on Standard Oil Co. of Texas 1 Jap Beck, all-important link test between North Snyder field and its south extension area. Right: One of three rigs operated by Two States Drilling Co. in the North Snyder area. This rig is at work on Cities Service Oil Co.'s Uda Wasson lease

powered. Of the rigs at work in Scurry reef fields fewer than a half dozen employ standard derricks and all are diesel, gas, or butane-engine powered.

The rigs mostly are in the medium-depth class, and are equipped with mast-type derricks which can be readily raised or lowered when making long moves. Substructures used vary from around 4 to 12 ft. in height, with 8-ft. units being the most common. Generally, the substructures are so designed that the rigs can be readily skidded, or rolled on Athey wagons, whenever short moves are made. All power pumps and other auxiliary equipment also are unitized so that a high degree of portability is offered.

A majority of the rigs are powered with two or three internal-combustion engines totalling about 550 hp. The heaviest rig in the field, owned by Sharp Drilling Co., has three 325-hp. engines. Slush pumps used, about 7½ by 15 in. in size, generally are V-belt driven from the drilling engines. Most rigs employ an auxiliary slush pump, sometimes individually powered, but some depend entirely upon the main pump.

With the exception of four or five rigs, all drilling is being done by contractors, either on contract for operators or on farmouts and leases held by the contracting company. In the accompanying photographs a good cross-section is offered of the types of drilling rigs being used.

Unlike drilling farther west in the basin, Scurry's fields offer few lost-mud-circulation problems. Maintenance of straight hole is not particularly difficult and little trouble is offered by high-pressure gas horizons.

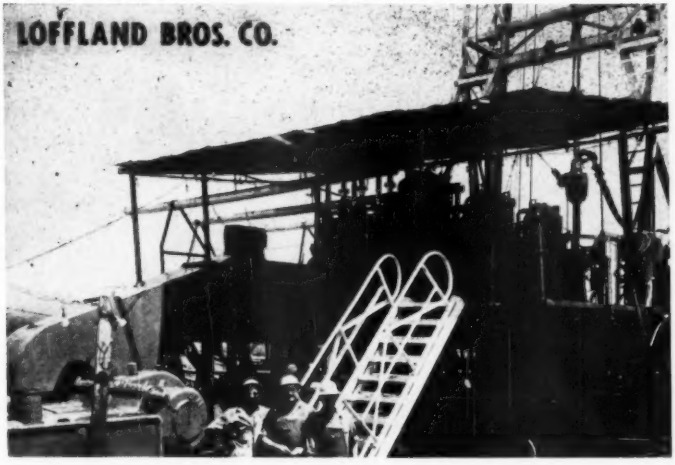
In North Snyder field, which is representative of practices followed in the other reef pools, a 12¼-in. hole is carried to below the top of the San Andres at about 1,650 to 1,700 ft. There a 9⅝-in. surface string is set with 1,250 to 1,700 sacks of cement. Hole is then reduced to 8¾ in. and carried to about minus 4,000 ft. subsea (average elevation is about 2,400 ft.) or some 10 ft. below the top of the reef. A 7-in. casing then is set with 600 sacks of cement.

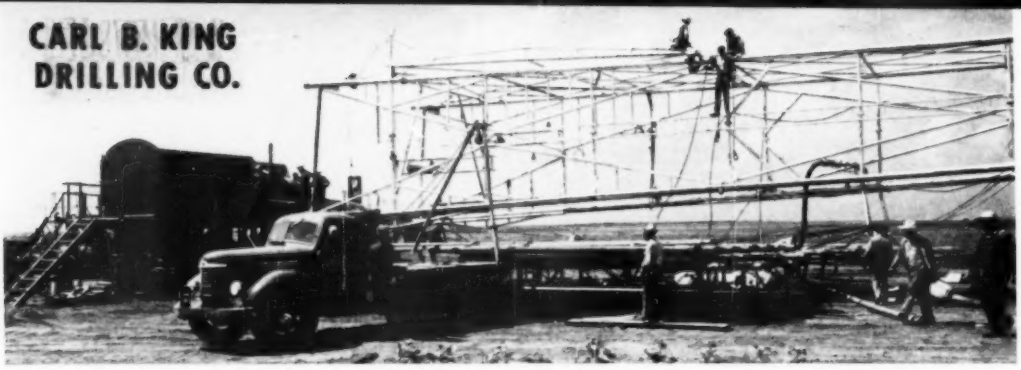
In completing wells located high on the reef, a 6⅛-in. hole is carried to some 50 or 100 ft. above the minus 4,500-ft. water level. In wells where a thin pay section is anticipated, 7-in. casing is not set until after a rat hole below the 8¾-in. main hole has proved the well to be productive.

Clear water is used as drilling fluid from the top of the hole to a point near the top of the thick shale section, encountered at about 5,800 ft. Soda ash and weighting materials are then added to bring the mud weight up to around 9.2 lb. per gallon. It also is conditioned to a viscosity of 42-45 seconds and to 15-20-cc. water loss. In drilling the 900 to 1,000-ft. shale section mud weight builds up to about 9.8 to 10.0 by the time the top of the reef is reached. After the reef is topped, mud viscosity is increased to 50-60 seconds in order to assure a clean hole for running electrical surveys.

Usually 4½-in. drill pipe is used in

One of two rigs operated by Loffland Bros. in Scurry County fields. The rig is drilling Standard of Texas 2-5 Brown, first North Snyder well to core the entire reef section. Continuous diamond coring was conducted for 1,319 ft., of which all but 12 ft. or better than 99 per cent was recovered. This was a record recovery for coring operations in area





Preparing to raise mast-type derrick of rig operated by Carl B. King Drilling Co. for another well in the Kelly area

drilling the main hole, with the weight on bit being supplied by 18 or 20 drill collars of $6\frac{1}{4}$-in. diameter. In drilling the shale section from 25,000 to 30,000 lb. is carried on the bit, while in the lime section about 50,000 lb. is carried. Rotary speeds of about 40 or 50 r.p.m. are used.

Over-all drilling time has been reduced until an average of about 32 days is required for each well. Actual net drilling time is around 500 hours per well, but some 29 or 30 drilling days are generally required. Lomax Brothers, Odessa drilling contractor, completed one well in 30 days' total time. From the time the rig was skidded in until total depth of 6,852 ft. was reached, only 25 days were required. At the time of completion this was believed to be a record for the area.

Usually about five $12\frac{1}{4}$-in. bits are used in drilling the 1,700 ft. of upper hole, and about forty $8\frac{3}{4}$-in. bits for the main hole. Medium hard rock bits are used for drilling except in the shale section where soft-formation rock bits are used. In the shale section penetration rates of about 18 ft. per hour are usually attained. A typical drilling-rate progress and bit chart, along with a type log of the formations being cut, is shown in an accompanying illustration. In the chart it will be noted that exceptionally good time was made in drilling the shale section.

Earlier this year contract prices averaged about $7.25 for wells with an $8\frac{3}{4}$-in. main hole and $6.75 for $6\frac{3}{8}$-in. hole. Prices have continued to fall, as contractors become better acquainted with the area, until most of the drilling is being done at around $5.75 per foot for $8\frac{3}{4}$-in. holes.

Recent Developments

Highlighting recent developments in North Snyder field was the completion of a $1\frac{1}{2}$-mile southeast extension. The stepout, Moncrief et al (Bob Hope, Bing Crosby, and Paul Teas of Dallas) 1 Huckabee, topped the reef pay at 6,475 ft. (minues 4,050 ft. subsea) and after cutting, 375 ft. of pay was completed for a potential of 1,078 bbl. daily.

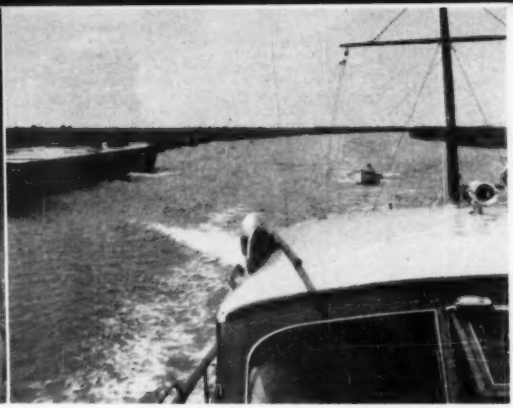
Between North Snyder field proper and its extension area to the south, two tests shortly will definitely prove whether the two areas are producing from the same reef as is thought to be the case. These two possible extensioners are Standard Oil Co. of Texas 1 Jap Beck in SW SW Section 393, and a west offset, Pure Oil Co. 1 C. B. Whatley.

North of the field proper 2 miles, Progress Petroleum Co. is drilling its 1 E. S. Carden in SW SE Section 503. This test is of special importance because it may set the north limit for the field. Northernmost producer completed to date on the crest of the ridge, Standard 5 on Brown lease 2, is also the highest well on the reef so that little is known as to the field's possible northern limit. The Standard 5 Brown was the first well to core entirely through the reef and was carried to the Ellenburger. It found bottom water in the reef pay at around minus 4,500 ft. subsea, thereby confirming the oil-water contact encountered in wells on the west and east edges of the field.

In the Kelly area major extensions to the east and northwest were completed during the past month. As a result of these extensions, and of recent completions cutting a thicker pay section than was found by Magnolia's first wells, drilling activity has been stepped up. Northeast of the Kelly area some 3 miles, and about an equal distance from the southernmost wells in North Snyder field, Standard-Fryer Drilling Co. 1 Wilkerson is a closely watched test. Located in Tract 24, Block 1, J. P. Smith Survey, the test will do much to prove whether the two pools are producing from one large massive reef or if they are separate reefs.

Those most optimistic about the area's possibilities feel it will take substantially more than 400 wells on a 40-acre spacing pattern to fully develop the reef trend. This belief is based largely on the fact that they expect drilling will prove the Kelly area to link with North Snyder field, resulting in continuous production throughout a distance of some 15 miles. Recent extensioners on the north of the Kelly area and Moncrief et al's successful wildcat $1\frac{1}{2}$ miles southeast of the North Snyder south extension area point to this possibility.

Rig of Clay & Gackle at work on one of Texas Standard's northernmost wells in North Snyder field. Arrangement of mud ditches and mud-handling equipment is typical of rig layouts in this area



Left: Albert H. Kammler, Core Laboratories, Inc., engineer, takes the suitcase lab out of a passenger car at a Grand Isle, La., boat landing. All five suitcases fit readily into a standard passenger car. Each weighs approximately 50 lb. and can be carried easily by one man. Kammler is preparing to put the suitcases on a crew boat to transport them to a California Co. offshore location. Right: Next step in the trip to the offshore location is a boat ride in a California Co. crew boat. The boat is moving down Bayou La Fourche en route to Bay Marchand field which is some 60 miles south of New Orleans and 4 miles offshore from Grand Isle, La.

"SUITCASE LABORATORY"

Highly portable equipment capable of complete core analyses

by Leigh S. McCaslin, Jr.
District Editor, Houston

ANALYZING cores in offshore or other inaccessible locations is now being accomplished successfully by use of highly portable equipment designed by its developers as a "suitcase laboratory."

Test apparatus capable of completely analyzing cores has been designed to fit into five containers resembling aluminum hand luggage. The total weight of the five "suitcases" is only 250 lb.—an average weight of 50 lb. Thus, this newly developed equipment can be moved easily by plane, boat, or passenger car to the desired well location.

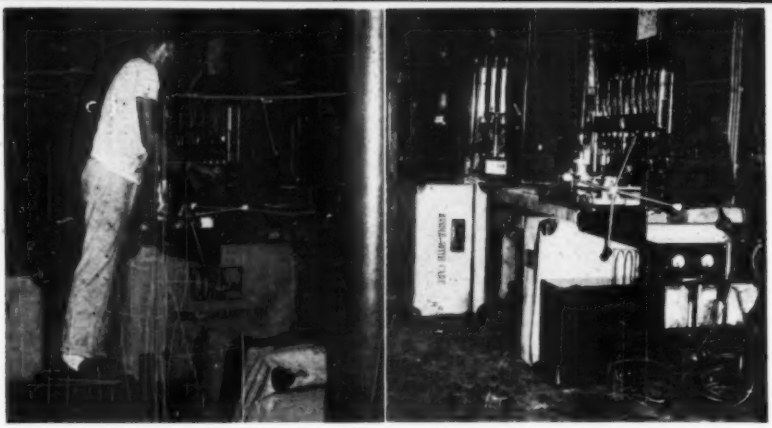
In the past it has been the practice, in some inaccessible locations, to freeze cores and take them to a base laboratory for analysis. For water locations, a core-analysis truck is sometimes transported to the well by barge, and either tied up alongside or transferred to the drilling platform. In the first case—freezing of cores—some transit time necessarily elapses before the cores can be analyzed and the data reported to the operator. In the second case—moving a truck to location by barge—considerable expense is involved.

The new suitcase lab overcomes both of these objectionable items. With the test equipment at the rig, the operator gets his core data and interpretations immediately and can proceed accordingly with the drilling or completion of the well. Because of its light weight and small cubage, the suitcase lab can be easily and inexpensively transported to any location —whether offshore, in the swamps of Louisiana, or in a remote mountainous region.

The suitcase lab was designed by Ben A. Elmdahl, district engineer, Houston, and Paul H. Smelker, assistant district engineer, Lafayette, La., both with Core Laboratories, Inc., Dallas. Equipment for the initial model was built in Houston and assembled in Core Lab's shops.

"Suitcase Laboratory No. 1" has been stationed at Lafayette, La., where it is operated under the supervision of engineer Albert H. Kammler. The Louisiana location was chosen for the first lab unit because of the many marine locations offshore

Left: The five containers comprising the suitcase lab are moved from the crew boat to the deck of the L.S.T. which serves as a drilling tender on California Co. offshore wells. The suitcases were easily handed from one man to another to get them aboard the L.S.T. Right: The suitcase lab is placed on the upper deck of the L.S.T. in a room adjacent to the radio room preparatory to setting up. A space only 6 by 10 ft. was needed for setting up the equipment



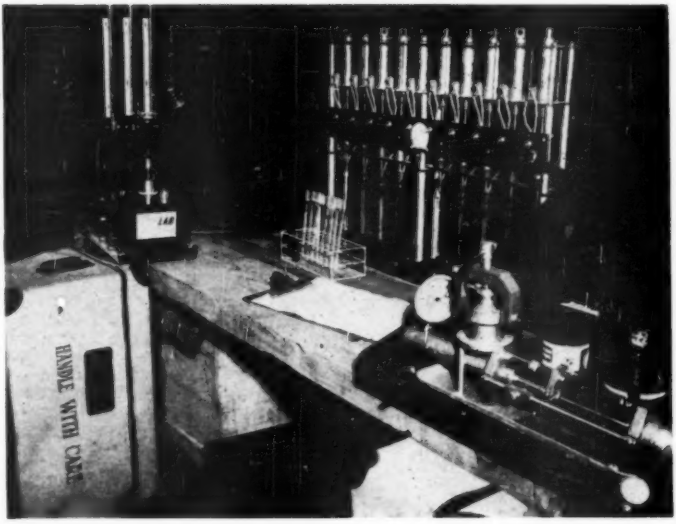
Extreme left: Kammler starts setting the lab up. One man can do everything necessary to set up and operate the equipment. Average time for assembling the equipment preparatory to analysis work is 15 minutes. Left: This picture shows the lab completely set up and ready to go. One box was not opened for the California Co. work. Since samples obtained in this area can be shaped with a knife, it was not necessary to set up Unit 4 containing the diamond drill, grinder, and diamond saw

and swamp wells drilled in South Louisiana. Although in use only a short time, the suitcase lab has been used on a number of offshore and swamp locations. The pictures accompanying this article were taken on a job performed for The California Co. in its Bay Marchand field which lies offshore of Lafourche Parish, some 60 miles south of New Orleans.

For The California Co. job, the unit was transported by passenger car to a boat landing at Grand Isle, La., where it was loaded on a crew boat for the trip to the rig. Because of the light weight of the five suitcases, they were easily handed from one man to another in loading and unloading.

The lab was set up in a 10 by 6-ft. space in a small room on the upper deck of the L.S.T. being used to drill the well. The only equipment necessary to set the lab up, other than the boxes in which the apparatus is carried, was a 3 by 6-ft. board. The empty boxes were used to support the board which provided working space. Average time to set the lab up and have it ready for analyzing cores is 15 minutes. The lab is completely self-sustaining with one exception. About 3½ kw. (for full-capacity operation) of rig power is necessary to run the electrical apparatus involved.

For most jobs, one man can operate the equipment. If an unusual amount of rapid coring is to be done, it may be necessary to add a second man. By way of contrast, the standard truck laboratory employs a two or three-man crew.



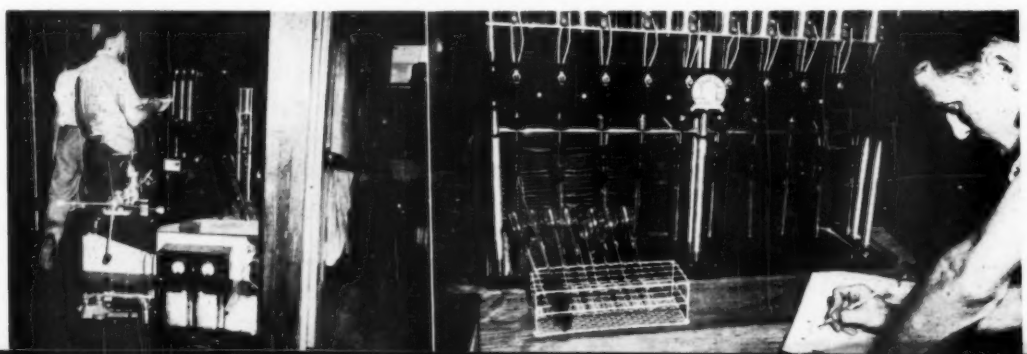
In this closeup view, the permeability apparatus can be seen on the left, retorts in the center, and mercury pump at the right. In setting up the laboratory, in this instance, the only equipment required other than the suitcases was a 3 by 6-ft. board. The empty boxes were used to support the board

The core-analysis equipment is distributed among the five units comprising the suitcase lab as follows:

Unit 1—Permeability apparatus.
Unit 2—Porosimeter.
Unit 3—Retorts and still.
Unit 4—Grinder, diamond saw, and diamond bit.
Unit 5—Miscellaneous equipment

(Continued on page 282)

Left: Merle E. Mumma, Core Lab engineer, checks the permeability apparatus for proper operation. Right: In this closeup, James E. Cotter, assistant engineer on the unit, records some core data on a sample from the California Co. operation. The retorts can be seen in the background



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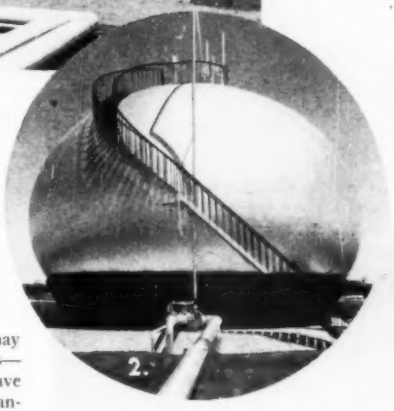

All of the tanks in the accompanying views are located at the Stanolind Oil & Gas Company's gasoline plant in the Slaughter Field in Hockley County, Texas.

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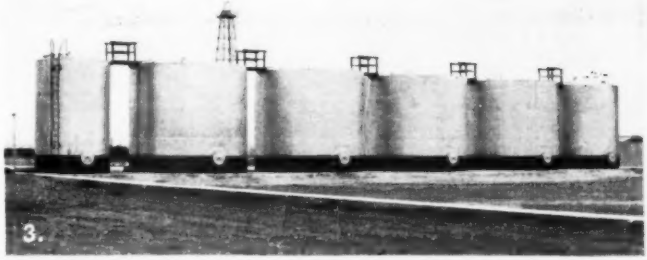

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Detroit, 26.....1514 Lafayette Bldg.
Havana.....402 Ahrea Bldg.
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Los Angeles, 14.....1523 General Petroleum Bldg.
New York, 6.....3347—165 Broadway B'dg.
Philadelphia, 3...1615—1700 Walnut Street Bldg.
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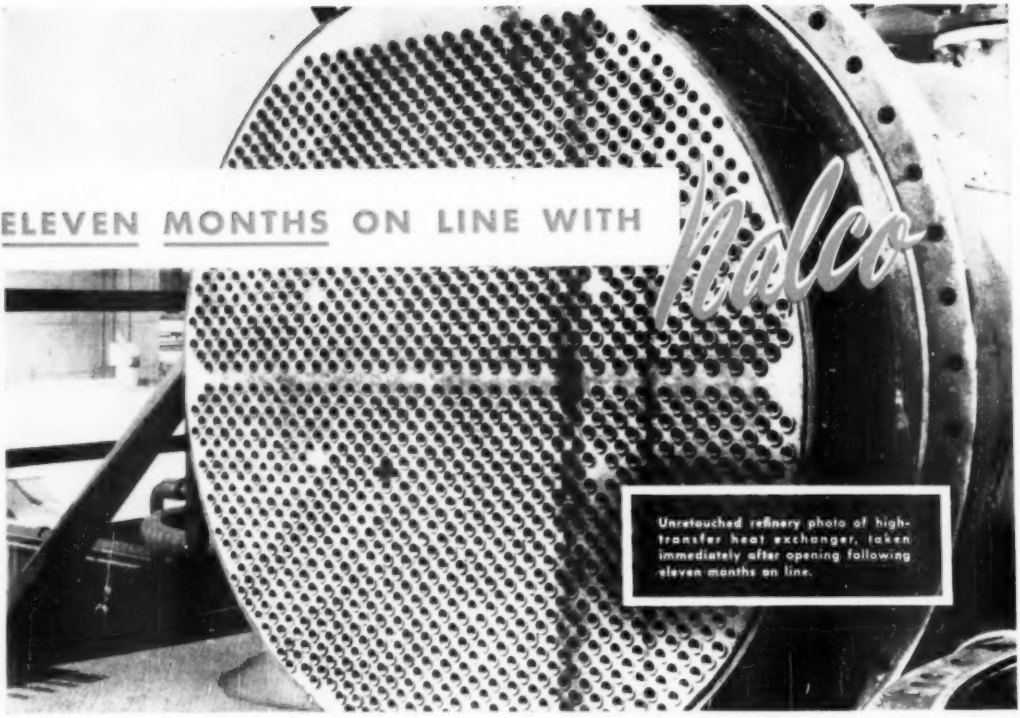
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DEEP-DRILLING TREND CONTINUES

by John C. Reidel

The possibility of obtaining commercial production from deep areas below present producing horizons has been highlighted by recent record drilling depths and the continued general trend toward deeper drilling. On the following page is a map showing the deep basins of the United States, the concentration of most productive areas, and the areas where new oil fields are possible. A table which accompanies this map summarizes the possibility of finding commercial oil in the deepest areas. Latest deep drilling and producing records, compiled by the Journal staff, are listed in two additional tables.

THE big story in deep drilling for 1949, and a landmark in drilling achievement for all time, is of course the 20,521-ft. depth reached by Superior Oil Co. in Sublette County, Wyoming. Prior to drilling the world's first 20,000-ft. well in Wyoming, Superior had drilled to 18,734 ft. in Ventura County, California, in early 1949, and to 17,823 ft. in Caddo County, Oklahoma, in 1947. The Standard Oil Co. of California well in Ventura County, California, hit 17,696 ft. in 1948. Taken together, this is not only impressive but points to the increasing practicability of drilling to these depths, made possible in the first place by the availability of heavy specialized rigs to do the job.

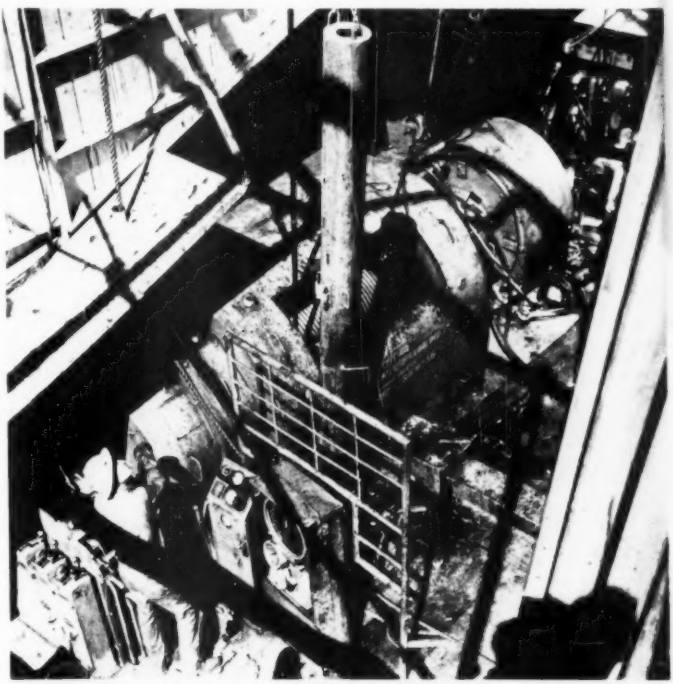
While attention is focused on the spectacular depths just mentioned, sight must not be lost of the possibly less spectacular but very significant general trend toward deeper drilling in the United States. For the first 6 months of 1949, 541 wells were drilled to depths below 10,000 ft. as compared with 441 during the same period of 1948. In the same 6-month period the number of wells drilled between 7,500 and 10,000 ft. went up from 928 in 1948 to 1,076 in 1949. Among other things, these figures reflect major developments in drilling equipment, first as applied to deep drilling, and second as reflected through the whole industry, contributing to the general progress in drilling equipment and practice.

Greater Capital Investment

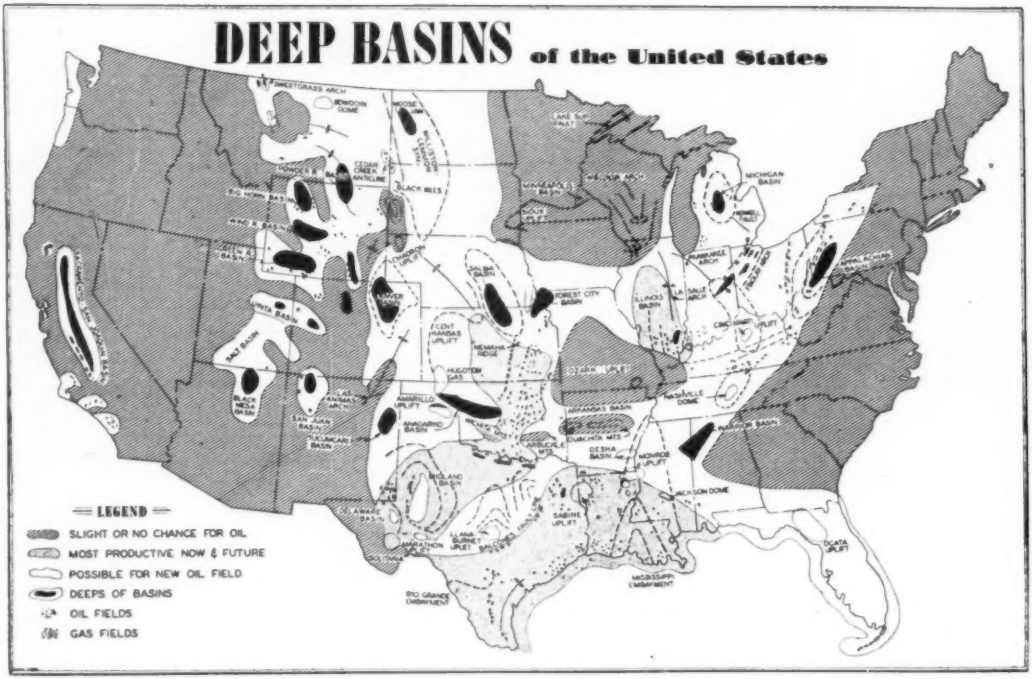
To drill deeper wells has meant greater capital investment in larger and more efficient rigs. However, utilization of the newer equipment has not only made possible deeper wells but also the drilling of more wells. It must be recognized that in recent years more wildcats have been drilled and more wells with abnormal pressures and other complicating conditions have been encountered, leading to an increase in the time required for completions. In spite of this there has been a reduction in the over-all rig time per well. Reflecting the entrance of the heavy modern rig into the picture, together with better handling of the drill string and reduction of fishing jobs, has resulted in a decrease of better than 30 per cent on the average in the total rig time per well for deep wells in the 10,000-12,000-ft. range over the 10-year period concluding with the end of the war. This has been accomplished despite the equipment shortages and inefficient labor of the war years. Wartime drilling reached a peak in 1945 and since then drilling contractors' figures show that the industry has obtained an added 20 per cent increase in drilling time for wells of all depths.

Progress in Equipment

Advancements in engineering practice, special equipment, and metallurgical science have gone into the design and manufacture of today's drilling equipment. Particularly notable developments are in unitization of rigs; increase in power and more effective use and distribution of power; semiautomatic and automatic rig controls; better hoisting equipment; improvements in bits, drill pipe, and many other items. Moving and rigging-up time has been greatly reduced and a greater percentage of time is being spent on bottom making hole than ever before.



The latest and deepest drilling achievement is the Superior Oil Co. Pacific Creek 1 Unit. This photograph shows the driller's position on the big rig at that location



Deep areas and possible production of oil and gas from the deepest formations are summarized by this map and table. (Courtesy of Dorsey Hager, consulting geologist, Centralia, Ill.)

Main Deep Areas of the United States

State and name of area—	Est. maximum thicknesses of sediments (ft.)	Chances of finding commercial oil in deepest part
Washington-Oregon:		
Washington-Oregon	40,000	Slight
California:		
Ventura Avenue area	50,000	Good to 20,000 ft. plus
San Joaquin-Sacramento basin	65,000-75,000	Good to 30,000 ft. plus
Imperial Valley	17,000	Very slight
W. Carrizo Plain	40,000	Fair to 20,000 ft.
Los Angeles Basin	15,000+	Good to basement
Montana:		
South Central basin	12,000-15,000	Possible to granite
Wyoming:		
Big Horn basin	17,000	Good to Madison ls.
Powder River basin	18,000	Good to Madison ls.
Wind River basin	20,000	Good to Madison ls.
Green River basin	40,000	Good to Madison ls.
W. Colorado-Utah:		
Uinta basin	20,000	Fair through Pennsylvanian
Colorado River-Salt Basin	10,000	Fair through Pennsylvanian
Arizona:		
Black Mesa basin	8,000-10,000	Possible through Pennsylvanian
W. New Mexico:		
San Juan basin	14,000-15,000	Fair through Pennsylvanian
E. Colorado:		
Denver basin	20,000	Fair through Pennsylvanian
N. and S. Dakota:		
Williston-Lemmon	15,000	Fair through Ordovician

State and name of area—	Est. maximum thicknesses of sediments (ft.)	Chances of finding commercial oil in deepest part
Kansas-Nebraska:		
Forest City-Salina basin	4,500-5,000	Some changes to Ordovician
Oklahoma:		
Anadarko basin	25,000+	Good into Arbuckle ls.
Texas:		
South Texas-Gulf Coast	25,000+	Good
West Central Texas	5,000-15,000	Good
North Texas	6,000-10,000	Good
Delaware basin	20,000	Good
Midland basin	18,000	Good
Illinois-Indiana:		
Illinois basin	10,000-12,000	Some changes to Cambrian
Michigan:		
Michigan basin	13,000-14,000	Fair chances through Trenton
Penn.-W. Va.:		
Appalachian geosyncline	30,000+	Fair through Ordovician
Louisiana:		
South	25,000+	Good
Mississippi:		
South	20,000+	Good
Alabama:		
Southwest	15,000-20,000	Fair
Black Warrior basin	12,000+	Fair
Georgia:		
Southeast	5,200	Slight possibilities
Southwest	8,000	Slight possibilities
Florida:		
Southern	20,000+	Fair

U. S. Drilling Depth Records by States

State—	Well and location: county	Result	Year comp.	Deepest formation	Total footage
Wyoming	Superior Oil Co. 1 Unit, 27-27n-103w; Sublette Co.	Dry	1948	U. Cretaceous	20,521
California	Superior 1 Limoneira, 9-2n-22w; Ventura Co.	Dry	1949	Upper Miocene	18,734
Oklahoma	Superior 51-11 Weller, 11-8n-12w; Caddo Co.	Dry	1947	Pennsylvanian	17,823
Upper Gulf Texas	Phillips 3 Schoops, Millican Salt Dome; Brazos Co.	Dry	1945	Cretaceous	16,855
East Texas	Humble Oil & Refining Co. 1 McWatters; Freestone Co.	Drlg.		Cotton Valley	16,347
South Louisiana	Texas Co. 4 State-Barataria Bay, Queen Bess Island; Jeff. Parish	Dry	1948	Miocene	16,108
Lower Gulf Texas	Texas Co. 8 Yturria L. & L. Co., Raymondville; Willacy Co.	Dry	1947		16,008
Mississippi	Superior 1 Bradford, 1-3n-13w; Forrest Co.	Dry	1946		15,730
Alabama	Humble 2 Williams, 21-6n-4w; Washington Co.	Dry	1949		15,659
South Texas	Quintana Petroleum 3-D So. Tex. Syndicate; McMullen Co.		1945	Cretaceous	15,301
West Texas	Phillips 1 Price, T.C. Railway Sur.; Pecos Co.		1944	Ellenburger	15,279
Florida	Gulf Refining Co. 1 State; Monroe Co.	Dry	1947		15,155
South Central Texas	Stanolind Oil & Gas Co. 1 Henry; McMullen Co.	Dry	1948		14,046
Southeast New Mexico	Phillips 4 State-Lea-Mex., Maljamar; Lea Co.		1945	Ordovician	13,998
Utah	Equity Oil Co. 1 Unit, 33-21s-21e; Grand Co.	Drlg.	1949		13,630
North Louisiana	Union Prod. 1 McDonald Unit, No. Lisbon field; Claiborne Parish		1942	Smackover	12,952
Colorado	Texas Co.-California Co. 20 Unit, 34-3n-94w; Rio Blanco Co.	Dry	1946	Madison	12,702
East Texas Border	Humble 1 Pickering Lumber; Shelby Co.		1946	Jurassic	12,221
Panhandle Texas	Phillips 1 Jenkins; Roberts Co.		1948		11,730
Arkansas	Stanolind 1 Bodcaw, 29-19s-23w; Lafayette Co.		1948		11,434
Montana	Shell Oil Co. 1 Crow Tribal 7904, 36-9s-37e; Big Horn Co.	Dry	1949	Granite	11,074
Michigan	Ohio Oil Co. and Pure Oil Co. 1 Reinhardt, 35-22n-2e; Ogemaw Co.	Dry	1948	Cambro-Ord.	11,012
Washington	Standard Oil Co. of California 1 Alderwood; Snohomish Co.	Dry	1947		11,002
Pennsylvania	Manufacturers Heat & Light Co. 8 Barton Est.; Butler Co.	Dry	1949		10,312
North Dakota	California Co. 1 Kamp, 3-154n-96w; Williams Co.	Dry	1938	Devonian	10,281
North Carolina	Standard Oil Co. of N. J. 1 Hatteras Light; Dare Co.	Dry	1946	Granite	10,054
West Virginia	Hope Natural Gas 8517 Gribble, Grant dist.; Harrison Co.	Dry	1941	Queenston	10,018
Northwest New Mexico	Southern Union Prod. 9 Barker Creek, 21-32n-14w; San Juan Co.	Gas	1945	Pennsylvanian	9,468
North Central Texas	Standard Oil Co. of Texas 2 Beasley, McKerley Sur.; Cooke Co.		1948		9,164
New York	New Penn Dev. 1 Herrington, Woodhull Twp.; Steuben Co.	Gas	1944	Oswego	8,625
Kansas	Stanolind 1 Feathers, 15-35s-33w; Seward Co.	Gas	1947	Crystalline	8,243
Maryland	Snee 1 Scharizer; Garrett Co.	Dry	1941	Helderberg	8,165
South Dakota	Northern Ordnance 1 Harding School Land, 1-17n-1e; Harding Co.	Dry	1943	St. Peter	8,000
Ohio	Penn-Ohio 1-C Knowlton, Sec. 10, Indep. Twp.; Washington Co.	Dry	1933	Silurian	7,889
Georgia	Warren & Robinson 1 Chandler, Ld. dist. 26; Early Co.	Dry	1944	Granite	7,320
Illinois	Pure Oil Co. 3 Billington, 26-1n-7e; Wayne Co.	Dry	1940	St. Peter	7,207
Nebraska	Union Oil Co. of California 15 Agate; Sioux Co.	Dry	1938	Pennsylvanian	6,848
Kentucky	Ashland Oil & Refining Co. 1-A Walker, 22-N-24; Webster Co.	Dry	1949	Knox	6,686
Indiana	Continental Oil Co. 1 Cooper Est., 13-3s-14w; Gibson Co.	Dry	1947	Trenton	6,405
Tennessee	California Co. 1 Beeler; Giles Co.	Dry	1947	Granite	5,750
Iowa	Oil Development 1 Wilson; Page Co.		1930	Cambrian	5,305
New Jersey	W. & K. Oil 1 Mathews, Jackson Mills; Ocean Co.	Dry	1929	Wissahickon	5,022
Missouri	Strake Petroleum Co. 1 Russell; Pemiscot Co.	Dry	1941	Cambrian	4,740
South Carolina	Parris Island; Beaufort Co. (water supply well)	Dry	1940	Crystalline	3,450

U. S. Producing Depth Records by States

State—	Well and location: county	Result	Year comp.	Producing formation	Producing footage
Alabama	Hunt Oil Co. 4 Land, Gilbertown field; Choctaw Co.	Oil	1945	Eutaw	3,624
Arkansas	Tide Water-Seaboard 1 Bandlow, Pattonfield; Lafayette Co.	Oil	1944	Smackover	9,330
California	Standard of California 5 Mushrush, Kern Co.	Oil	‡1949	Eocene	15,475
Colorado	Texas Co.-California Co. 10 Unit, 26-3n-94w; Rio Blanco Co.	Oil	1941	Morrison	7,198
East Texas	Humble 1 Curtis, Larissa field; Cherokee Co.	Oil	1942	Pettit	10,312
East Texas Border	Magnolia Petroleum Co. 1 Orr, Fowler Sur.; Marion Co.	Oil	1946	Travis Peak	7,577
Florida	Humble 1 Gulf Coast, Sunniland field; Collier Co.	Oil	1943	Glen Rose	*11,626
Illinois	Kingwood Oil Co. 24-A Shanafelt, 20-2n-2e; Marion Co.	Oil	1943	Trenton	4,657
Indiana	Lewis 1 Hill, 35-3s-14w; Posey Co.	Oil	1939	McClosky	3,144
Kansas	Olson Drilling Co. 3 Morrison, Morrison field; Clark Co.	Oil†	1936	Viola	5,481
Kentucky	United Carbon Co. 1 Howe; Pike Co.	Gas	1932	Devonian	5,170
Lower Gulf Texas	Sun Oil Co. 1 Thompson, W. Goliad field; Goliad Co.		1945	Wilcox	11,149
Michigan	Turner Petroleum Corp. 1 Boettcher, 28-18n-2e; Osceola Co.	Oil	1945	Richfield	**9,160
Mississippi	Gulf Refining Co. 1 Majors, 29-6n-11w; Jones Co.	Oil	1948	Comanche	13,082
Missouri	Cities Service Oil Co. 1 Cook, Tarkio field; Atchison Co.	Oil	1940	Bartlesville	1,444
Montana	Stanolind 1 Laerr "B," 29-9s-23e; Carbon Co.	Oil	1948	Madison	6,880
Nebraska	Ohio Oil Co. 1 Mc. E. Egging, 11-15n-45w; Cheyenne Co.	Oil	1949	Muddy	4,429
New York	Kane 1 Lewis, West Union Twp.; Steuben Co.	Gas	1942	Oriskany	5,222
North Central Texas	Standard Oil of Texas 2 Beasley, McKerley Sur.; Cooke Co.		1946	Ellenburger	8,340
North Louisiana	James & Co. et al 2 Williamson, 28-23n-8w; Claiborne Parish	Oil	1948	Smackover	10,789
Northwest New Mexico	Southern Union Prod. 9 Barker Creek, 21-32n-14w; San Juan Co.	Gas	1945	Pennsylvanian	9,468
Ohio	East Ohio Gas Co. 1 Phillips, Sec. 23, Washington Twp.; Harrison Co.	Gas	1941	Silurian	*5,899
Oklahoma	Gulf Oil Corp. 1 Mainka, 12-5n-5w; Grady Co.	Oil	1948	Second Bromide	13,068
Panhandle Texas	Sinclair Oil & Gas Co. 1 C. S. Lips, 135-C-G&M Sur., Roberts Co.	Oil	1949	Mississippian	8,810
Pennsylvania	American Locomotive Co. 5 Steiner, Unity Twp.; Westmoreland Co.	Gas	1946	Oriskany	8,014
South Central Texas	Quintana Petroleum Co. 1 Mull, Mull field; Atascosa Co.	Oil	1946	Edwards	9,019
South Louisiana	Shell Oil Co. A-1 Smith, 18-14s-7e, Weeks Island; Iberia Parish	Oil	1948		14,255
South Texas	Plymouth Oil Co. 1 K. T. Darby, Jourdanton field; Atascosa Co.	Oil	1949		7,410
Southeast New Mexico	Mid-Continent Petroleum Corp. 1-B U. D. Sawyer, 34-9s-36e; Lea Co.	Oil	1948	Mississippian	12,460
Tennessee	Alvin York 2 Print Huff; Pickett Co.	Oil	1947	Knox	1,702
Upper Gulf Texas	Humble 1 So. Mayes Unit; Chambers Co.	Cond.	1948	Lower Frio	12,028
Utah	Mountain Fuel Supply Co. 2 Murphy, 21-3n-24e; Daggett Co.	Gas	1934	Dakota	6,750
West Texas	Texas Co. 1 Clarence Scharbauer, 20-40-T2S-T&P; Midland Co.	Oil	1949	Ellenburger	13,060
West Virginia	Ohio Oil Co. 1 Kay Kendall et al, Dry Fork dist.; Tucker Co.	Gas	1946	Oriskany	*8,410
Wyoming	Pure 1 Unit, 11-33n-84w; Natrona Co.	Oil	1948	Frontier	14,307

*Total depth figure. †Now abandoned. ‡Testing.

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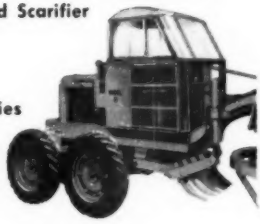

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More Footage Drilled With Fewer Rigs

Currently the big challenge to the driller is found in lower formations in deep sedimentary zones

by John C. Casper
District Editor

OPERATORS are drilling more footage with fewer rigs than they were last year at this time. In the postwar search for new oil to meet the rapidly increasing demand, all available drilling equipment was pressed into service. Material shortages often delayed active drilling. Soon after the middle of 1948 it became apparent that winter demands could be met and that the temporary shortage was over. More drilling equipment and materials were available. Some of the older rigs were replaced by more efficient equipment.

There are no data available on the number of cable tools in operation and no comparisons can be made for the territories where cable-tool drilling accounts for a major portion of completions.

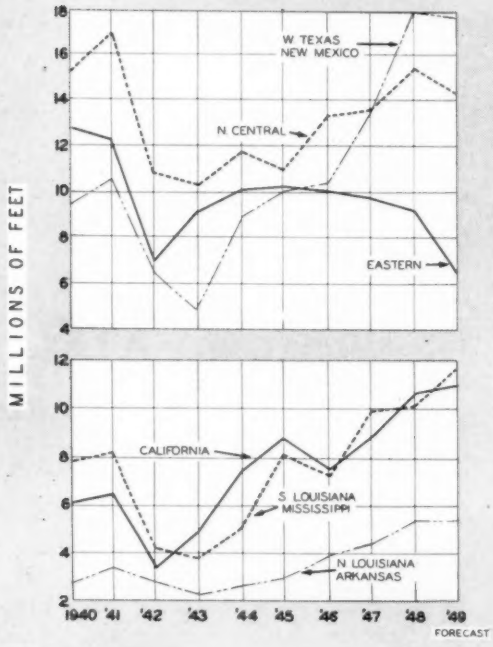
If we exclude the Appalachian and North Central districts and consider the totals for all other areas of the country, we find that the average number of rotary rigs operating at the beginning of each week in the first 7 months of this year amounted to 1,904 units. This is smaller by 49 rigs than the average for the same period last year or a decrease of 2.5 per cent.

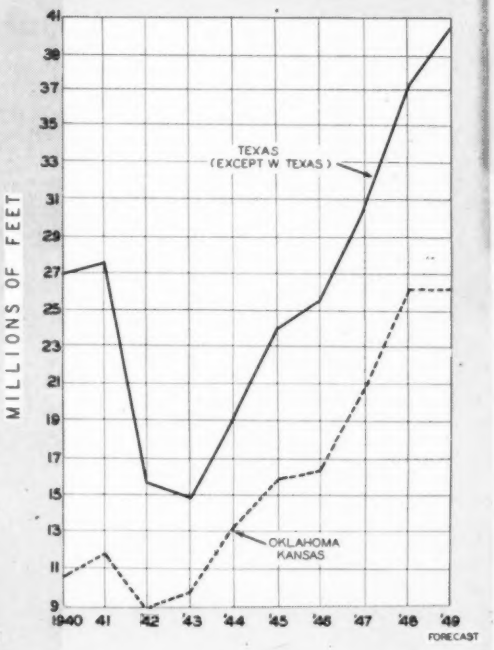
Total footage for this area, including all states west and south of Illinois, Kentucky, and Tennessee, was greater than in 1948. No information is available on the actual footage drilled by all rigs each week, but the total footage of all wells completed in the 7-month period is an indication of total drilling. Total footage for all wells completed in the area during the first 7 months of this year was 66,360,000 ft. compared with 61,501,000 ft. in the same period last year. On a daily average basis, this represents an increase of 8.4 per cent.

Drilling so far this year has been marked by sharp shifts by areas which are reflected in gains in average depth of all wells completed. The average for all of 1948 was 3,454 ft. compared with 3,627 ft. in the first half of this year. The Oil and Gas Journal drilling forecast at midyear indicates an average depth of 3,722 ft. for 1949.

The big jump in average depth has resulted from several changes in drilling trends. Declines in posted prices for Pennsylvania Grade crude have had a marked influence on the secondary-recovery program in the Appalachian area. Since wells in this area are relatively shallow, the decline in completions has tended to increase the average depth for the country as a whole. This is shown in the average depth trends for particu-

FOOTAGE DRILLED-By Areas

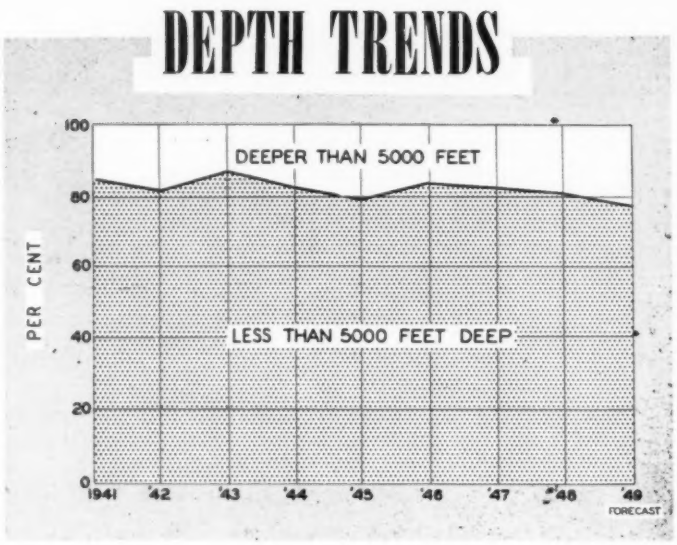




lar areas. The increase in average depth for all areas in the country, as shown by the midyear forecast, is 7.8 per cent over 1948. On the other hand, if we consider all districts except Appalachian and North Central, the gain is only 4.9 per cent.

The big gain in average depth for Louisiana is due to a shift from the relatively shallow areas in the northern part of the state to the deeper sections near the gulf. Completions in the Gulf Coast area of Louisiana in 1948 represented only 33 per cent of the state total. The ratio is expected to be about 45 per cent in 1949. The effect of such a shift is seen when we consider the average depth of wells in the northern part of the state, about 2,650 ft. compared with 8,830 ft. for the gulf areas.

California had a high percentage of shallow completions last year, resulting in a sharp decrease in average depth, but completions in 1949 are nearer the postwar normal. The forecast for the year indicates a de-



CHANGES IN DRILLING BY AREAS, 1940-49
(Thousands of feet drilled)

	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949 (forecast)	% change 1940-49
Eastern (N. Y., Pa., W. Va.)	12,666	12,212	6,923	9,071	10,038	10,225	9,985	9,702	9,293	6,425	— 49.3
Per cent of U. S.	13.6	12.4	11.4	14.8	12.4	11.0	10.3	8.5	6.8	4.6	
Ohio	2,110	3,354	2,875	2,493	2,730	2,689	3,402	3,913	3,498	2,522	+ 19.5
Michigan	2,165	1,998	1,673	1,548	1,620	1,963	1,749	1,935	1,983	2,308	+ 6.6
Indiana	901	981	736	428	581	500	1,071	1,206	2,023	2,180	+141.9
Illinois	9,424	9,462	5,027	4,668	4,958	4,565	5,925	5,251	6,386	5,667	— 39.9
Kentucky	602	1,189	417	1,182	1,863	1,275	1,175	1,194	1,515	1,557	+158.6
Total N. Central	15,202	16,984	10,728	10,319	11,752	10,992	13,322	13,499	15,405	14,234	— 6.4
Per cent of U. S.	16.3	17.2	17.6	16.8	14.6	11.8	13.7	11.8	11.2	10.3	
Oklahoma	4,904	5,531	3,934	3,945	7,172	10,048	9,771	12,151	15,515	15,950	+225.2
Kansas	5,714	6,353	4,795	5,808	6,194	5,877	6,556	8,690	10,634	10,266	+ 79.7
Total	10,618	11,884	8,729	9,753	13,366	15,925	16,327	20,841	26,149	26,216	+146.9
Per cent of U. S.	11.4	12.1	14.4	15.9	16.6	17.1	16.8	18.3	19.0	19.0	
East Texas	2,433	4,435	2,046	1,769	1,867	2,504	3,792	3,070	3,383	3,287	+ 35.1
N. Central Texas	6,661	6,460	3,085	4,097	4,395	5,864	7,065	8,544	11,312	13,348	+100.4
Panhandle	1,678	2,143	1,013	548	984	1,686	943	1,593	2,053	3,226	+ 92.3
Southwest Texas	8,703	7,525	5,073	4,805	2,312	2,254	2,138	7,454	8,575	8,663	— 0.4
Texas Gulf Coast	7,505	6,980	4,410	3,618	9,491	11,690	11,599	9,559	11,995	12,038	+ 60.4
Texas (ex. W. Texas)	26,980	27,543	15,630	14,835	19,049	23,998	25,537	30,220	37,318	40,562	+ 50.3
Per cent of U. S.	28.9	28.0	25.7	24.2	23.6	25.7	26.3	26.5	27.2	29.4	
West Texas	7,554	9,725	5,434	4,195	7,572	8,497	8,815	10,809	15,428	15,208	+101.3
New Mexico	2,000	754	1,148	770	1,322	1,508	1,624	2,512	2,602	2,601	+ 30.1
Total	9,554	10,479	6,582	4,965	8,894	10,005	10,439	13,321	18,030	17,809	+ 86.4
Per cent of U. S.	10.2	10.6	10.8	8.1	11.0	10.7	10.8	11.7	13.1	12.9	
North Louisiana	1,757	2,361	1,827	1,199	1,408	2,117	3,175	2,912	4,128	4,390	+149.9
Arkansas	1,002	911	1,033	1,095	1,190	828	728	1,409	1,270	1,009	+ 0.7
Total	2,759	3,272	2,860	2,294	2,598	2,945	3,903	4,321	5,398	5,399	+ 95.7
Per cent of U. S.	3.0	3.3	4.7	3.7	3.2	3.2	4.0	3.8	3.9	3.9	
South Louisiana	6,826	6,764	3,852	3,138	4,315	5,657	5,289	5,797	6,806	9,196	+ 34.7
Mississippi	1,019	1,406	377	635	776	2,403	1,971	4,131	3,312	2,479	+143.3
Total	7,845	8,170	4,229	3,773	5,091	8,060	7,260	9,928	10,118	11,675	+ 48.8
Per cent of U. S.	8.4	8.3	7.0	6.2	6.3	8.6	7.5	8.7	7.4	8.5	
Colorado-Utah	87	101	123	83	207	352	1,071	1,178	1,303	705	+710.3
Wyoming	583	496	793	557	907	967	716	1,203	2,501	2,866	+391.6
Montana	611	612	728	533	946	754	661	630	819	801	+ 31.1
Total Rocky Mountain	1,281	1,209	1,644	1,173	2,060	2,073	2,448	3,011	4,623	4,372	+241.3
Per cent of U. S.	1.4	1.2	2.7	2.0	2.5	2.2	2.5	2.6	3.4	3.2	
California	6,130	6,511	3,359	4,793	7,527	8,671	7,509	8,764	10,579	10,914	+ 78.0
Per cent of U. S.	6.6	6.6	5.5	7.8	9.3	9.3	7.7	7.7	7.7	7.9	
Miscellaneous	232	268	105	302	371	346	326	454	479	491	+111.6
Total United States	93,267	98,532	60,789	61,278	80,746	93,240	97,056	114,061	137,392	138,097	+ 48.1

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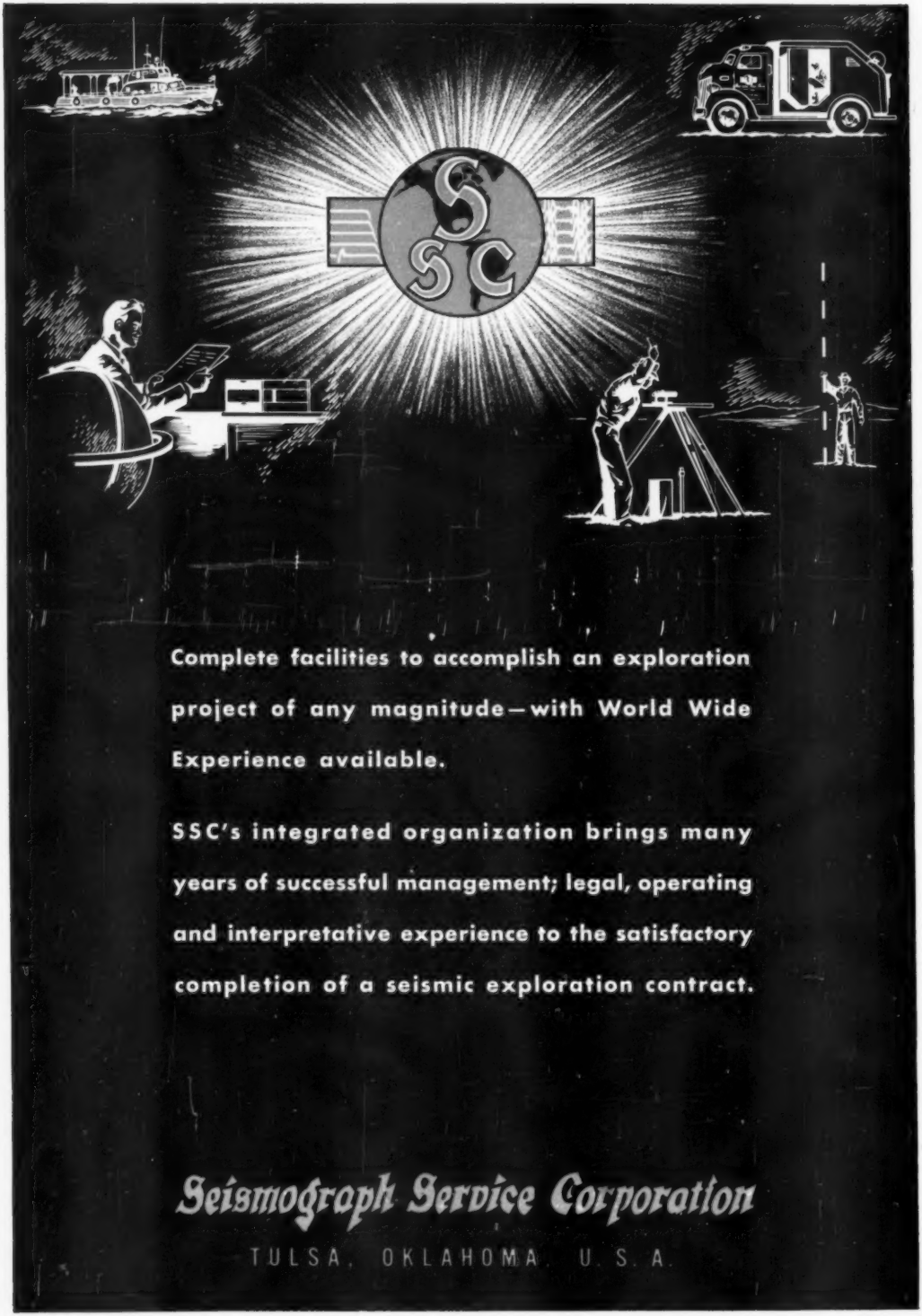

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Seismograph Service Corporation

TULSA, OKLAHOMA, U.S.A.

DRILLING—1949 (FORECAST) VS. 1948 (ACTUAL)
(By areas)

	Total completions			Footage (thou. ft.)		
	1949	1948	% change	1949	1948	% change
Texas-New Mexico	13,456	12,857	+ 4.7	56,371	55,348	+ 5.5
Southern area	2,984	3,101	— 3.8	17,356	15,780	+10.0
Oklahoma-Kansas	7,508	7,577	— 0.9	26,216	26,149	+ 0.3
Rocky Mountain	997	1,154	—13.6	4,372	4,623	— 5.4
California	2,445	2,876	—15.0	10,914	10,579	+ 3.2
Subtotal	27,390	27,565	— 0.6	117,229	112,479	+ 4.2
North Central	5,244	5,323	— 1.5	11,712	11,907	— 1.6
Eastern	4,369	6,742	—35.2	8,947	12,791	—30.1
Miscellaneous	100	148	—32.4	209	215	— 2.8
Total United States	37,103	39,778	— 6.7	138,097	137,392	+ 0.5

FOOTAGE DRILLED VS. NEW CRUDE FOUND
(Millions of feet—Millions of barrels)

Areas—	1941	1942	1943	1944	1945	1946	1947	1948	Total 1941-48
N. Cent. & Eastern:									
Footage	29.2	17.7	19.4	21.8	21.2	23.3	23.2	24.7	180.5
New oil	216	130	137	155	162	123	154	138	1,215
Bbl. per foot	7.3	7.3	7.1	7.1	7.6	5.3	6.6	5.6	6.7
Okla.-Kans.:									
Footage	11.9	8.7	9.7	13.3	15.9	16.3	20.8	26.2	122.8
New oil	270	169	128	241	95	244	318	674	2,139
Bbl. per foot	22.7	19.4	13.2	18.1	6.0	15.0	15.3	25.7	17.4
Ark.-La.-Miss.:									
Footage	11.4	7.1	6.1	7.7	11.0	11.2	14.3	15.5	84.3
New oil	300	249	207	430	365	281	427	402	2,661
Bbl. per foot	26.3	35.1	33.9	55.8	33.2	25.1	29.9	25.9	31.6
Tex.-N. Mex.:									
Footage	38.0	22.2	19.8	27.9	34.0	36.0	43.5	55.3	276.7
New oil	881	1,087	389	746	836	1,641	979	1,680	8,239
Bbl. per foot	23.2	48.9	19.6	26.7	24.6	45.6	22.5	30.4	29.8
Rocky Mountain:									
Footage	1.2	1.6	1.2	2.1	2.1	2.5	3.0	4.5	18.2
New oil	36	128	200	176	235	85	251	104	1,213
Bbl. per foot	30.0	78.7	166.6	84.1	111.9	34.0	83.7	23.1	66.6
California:									
Footage	6.5	3.4	4.8	7.5	8.7	7.5	8.8	10.6	57.8
New oil	262	121	425	319	392	291	334	809	2,953
Bbl. per foot	40.3	35.6	88.5	42.5	45.0	38.8	38.0	76.3	51.1
Miscellaneous:									
Footage	0.3	0.1	0.3	0.4	0.3	0.3	0.5	0.6	2.8
New oil	1	1	1		3	1	8	1	16
Ttl. United States:									
Footage	98.5	60.8	61.3	80.7	93.2	97.1	114.1	137.4	743.1
New oil	1,966	1,883	1,487	2,067	2,088	2,666	2,471	3,808	18,436
Bbl. per foot	20.0	30.9	24.3	25.6	22.4	27.4	21.7	27.7	24.8

crease of 15 per cent in completions with a gain of 3.2 per cent in footage.

Changes in depth trends are indicated by the breakdown of total completions into depth classifications. In the first 7 months of this year, there was a decline in the number of wells with depths less than 5,000 ft. and gains in all other classifications. Wells less than 5,000 ft. represented 80.5 per cent of the total last year but had dropped to 78.6 per cent in the January-July period of this year. On the other hand, wells deeper than 10,000 ft. gained from 2.4 per cent of completions last year to 2.9 per cent this year. The greatest commercial gain is recorded for wells in the 7,500-10,000-ft. classification. Completions in this group were up 278 wells or 11 per cent.

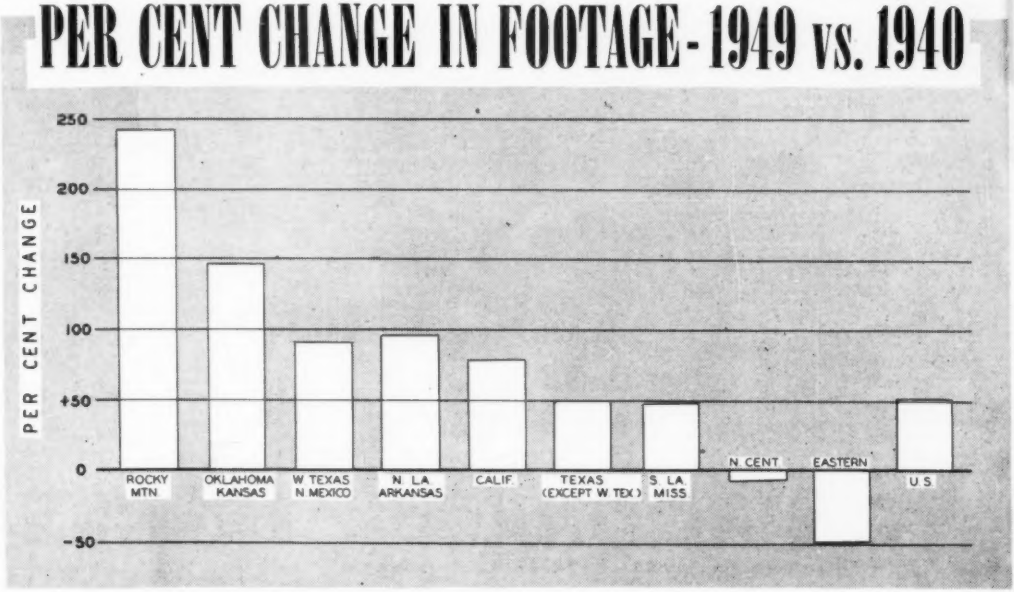
It can be seen from the above data and also an accompanying chart that, despite the trend toward deeper drilling and the increase in average well depth, the relatively shallow wells, under 5,000 ft., still account for the bulk of all completions.

There is one fundamental principle governing the search for oil. The only sure way to tell if a formation contains oil is to drill a hole. Many improvements have been made in methods of selecting the place to drill, but the final test is the drill itself.

In the past, there has been a rather definite correlation between the total footage drilled and the volume of oil found. Data from past years indicate that we find more oil when we drill more hole.

Past experience has shown that the desirable level for crude and light-products reserves is about 12.5 times

(Continued on page 282)



This KB-8-F helps crews keep oil wells on their good behavior!

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1. International Trucks are exactly right for the job. International offers America's most complete line of trucks. 22 basic models, 1,000 truck variations range in GVW from 4,400 to 90,000 lbs. Axles, transmissions, engines, tire equipment, and other specialized units and parts are available to meet every hauling requirement.

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3. International Trucks are easily serviced. America's largest exclusive truck service organization stands behind every International Truck. 4,700 International Truck Dealers and 172 Company-owned Branches offer precision-engineered replacement parts, factory-rebuilt exchange units, factory-trained mechanics.

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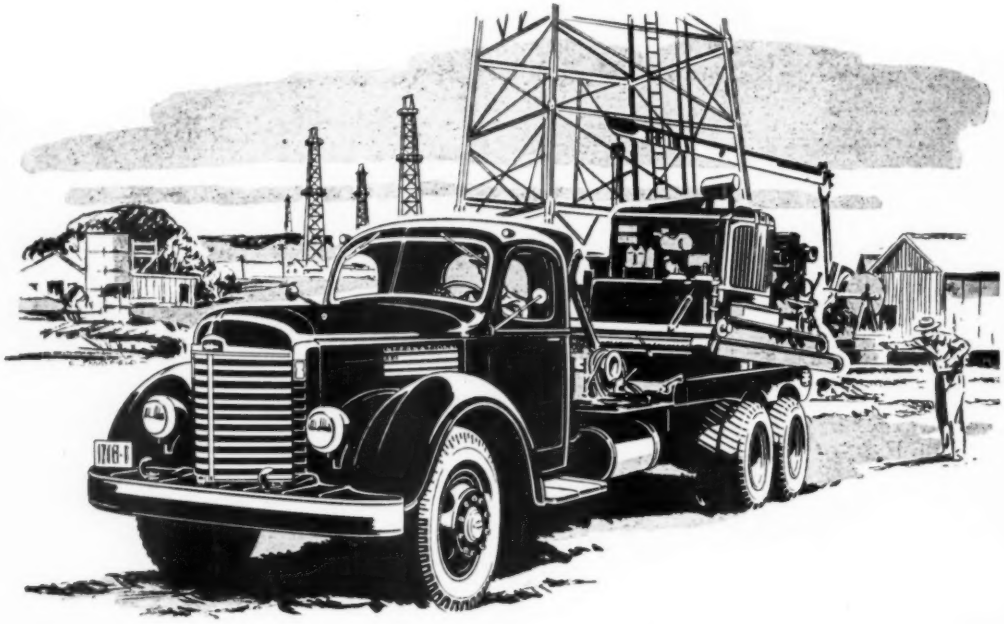
Tune in James Melton and "Harvest of Stars"
NBC, Sunday afternoons



INTERNATIONAL TRUCKS

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Inventory System

as used by Helmerich & Payne

Speeds Checking of Equipment on Drilling Rigs

by Roy F. Carlson
District Editor

Twenty rigs and two warehouse yards are completely inventoried in the filing system, shown here being inspected by Herman Aweas, drilling superintendent for Helmerich & Payne

TO speed checking of equipment on drilling rigs when such an operation is necessary, Helmerich & Payne, Inc., Tulsa, has devised a new, rapid, and thorough method of keeping inventory records on rig machinery. Each item of equipment is inventoried and crossindexed by this system so that location of any machine or major tool means only a few minutes of checking. Devised primarily as an equipment check, the method seems to have considerable merit as an accounting device. A separate benefit evolves from the system by its making field personnel equipment conscious.

Seventeen rotary rigs, two warehouse yards, and three cable-tool rigs are completely carded and indexed in the filing system, from draw works and motors to wire lines and hand tools. Each item is listed on a separate card with each card giving a description of the tool, its code number, serial number, make, model, size, capacity, use description, and in most cases listing initial cost. The various pieces of equipment are readily found by means of a visual coding and card index system which is housed in a loose-leaf notebook, a portfolio-type binding, and a series of three drawer-type Kardex files.

ITEM DRAW WORKS — INVENTORY NO 10-1

DESCRIPTION Oil Well Hoist 96 12,000 ft. H 14 A 15
Double drum incl. coring line w/6 forward speeds, chain drive, clutches & sand reel, friction clutch, twin disc clutch Made
Model EK-224 skids 20½ x 8 19 x 8 x ½ I beams, incl. rotary chain guard.

DATE	REFERENCE NUMBER		2-47	USE	RIG NO	STATE	VALUE AMOUNT	VALUE BALANCE
5-24-48		Inventory OW-15850			35	L	$	$

ITEM — INVENTORY NO. 10-1

TYPIST PLEASE NOTE—THIS SCALE CORRESPONDS TO TYPEWRITER (PICA) SCALE ... HELMERICH & PAYNE, INC. DRILLING EQUIPMENT—FORM A

A draw-works file card, typical of those for most other pieces of equipment

To formulate the filing system, a master code was first devised, with each item of major equipment assigned a code number, starting with the number 10, which designated the draw works. Equipment items were organized functionally and numbered consecutively in the order in which they could best be inventoried. A lapse in the numbering system from 59 to 70 allows for new kinds of equipment which may be developed in the future. Numbers from 70 through 75 include such material as drill pipe, drill collars, line pipe, wire line, subs, and a miscellaneous category of hand tools, belting, hose, lumber, and the like.

Each unit of one of these groups of major equipment items was then numbered in series, the first draw works being given the code-serial

HOW *Deep* CAN A WELL BE

No one knows how much deeper men will drill for oil. However, Lee C. Moore drilling structures have been used on several record wells, one of which was drilled to over 20,000 feet.

For over forty years Lee C. Moore has kept pace with the oil industry by designing and building structures needed to drill deeper and deeper. Lee C. Moore Super-Kay derricks are now available for drilling beyond 20,000 feet.

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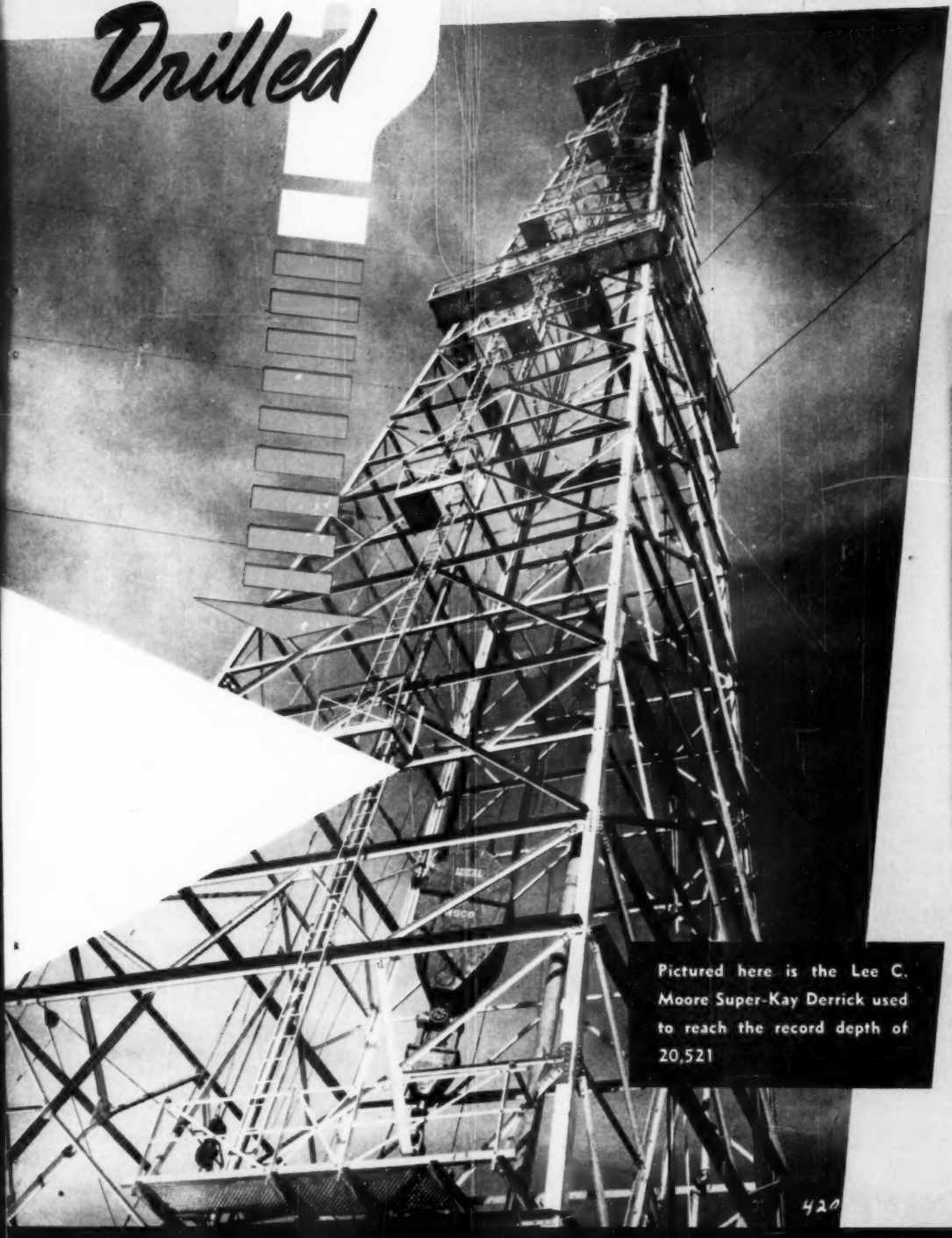

Pictured here is the Lee C. Moore Super-Kay Derrick used to reach the record depth of 20,521

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number 10-1, the second 10-2, and so on through all the draw works. Another group of one kind of equipment, perhaps the crown block, would carry the code number 11, each unit of which would be given a serial number. When an item of equipment is assigned a code number, that number is permanently die stamped into it.

In preparing the inventory file, a master sheet was first prepared which included the code numbers, and all data about the equipment which were later to be placed on the file cards. This information compiled on the master sheet is placed on the top few lines of the card illustrated.

When a complete series of these cards for one rig has been prepared, it is placed in a card file drawer, and is marked with the date of completion of the file. Since there are 65 items in the equipment list for a rig, two drawers in the metal cabinets are used. A duplicate set of these cards for all rigs in a district of the company is prepared and kept in the district office. The original rig assignment and inventory data are placed on the card at the time of formation of the card file.

When any transfer of equipment is made, notice of the move is sent to both the district office and to headquarters in Tulsa, and the transfer is noted on the card by date, inventory number and new assignment. Cards carry a purchase value of the equipment and although depreciated values of the machinery could be posted, they are not.

The cards carrying code numbers from 70 through 75 on which pipe is inventoried are made up a little differently from that illustrated since, because of the nature of the equipment, it would be difficult to record each unit. These cards have a complete description of the pipe as is given for other tools, but the data for inventory and transfer include details as the date of transfer, a reference number, the number of joints, and the total footage to and from the rig, and the remainder at the rig, and a classification of the pipe condition.

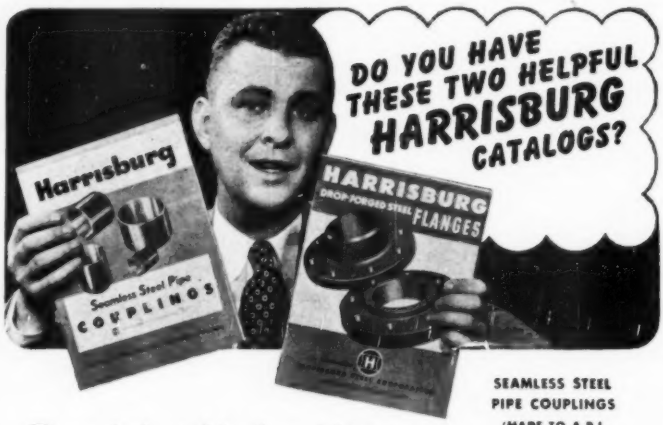
A crossindexing provision is made in the portfolio binding which holds a separate small Kardex file. Each of these cards is labeled with a code number for one group of equipment. The card lists a series of numbers from one through 100 in groups of 10 on the left side of the card, (1-10, 11-20, 21-30, etc.) opposite a horizontal line of 10 spaces. Each of these spaces, therefore, corresponds to a number in the group, reading from left to right across the card opposite the group of numbers. Therefore, the fifth space in the second row would be number 25. If the card carried the code number 10, that space would represent draw works number 25, the card number and the space number being the number stamped on the machine. If the number of the rig to which this equipment is assigned is placed in the space representing the number of the equipment the item is crossindexed.

A check on the life of the equipment and the service it has rendered is easy to make because a record of the final disposition of the machinery is kept on the card. This record separates the disposal into sold, exchanged, junked, or lost. These cards are kept separately.

In addition to equipment assigned to rigs, all material in warehouse stock is also carded and indexed in a manner similar to that described above, so that transfers into and from warehouse stock may be followed.

To further facilitate inventories, the three different areas in which the company maintains a district office are each assigned a different color, a strip of paper marked with that color being placed in a recess in the front of correct drawers for either rigs or warehouses.

Cards for the filing system are specially printed on heavy paper and contain ruled columns for all the desired information. A complete equipment inventory for the 20 rigs and 2 warehouse yards is kept in a metal filing case measuring about 2 ft. in height, 3 ft. in width, and 2 ft. in depth.



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They're chock-full of practical selection tables, charts, and technical information on Harrisburg Seamless Steel Pipe Couplings and Drop-Forged Steel Pipe Flanges.

We think everyone interested in these two important items of oil field equipment should have these catalogs on file. Use the coupon, or write us a postcard or letter.

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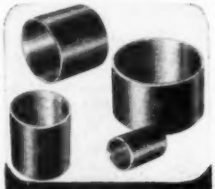

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Pictured above is Raymond's 1300-pile foundation for the new Caterpillar Tractor Company Building LL at Peoria, Ill.

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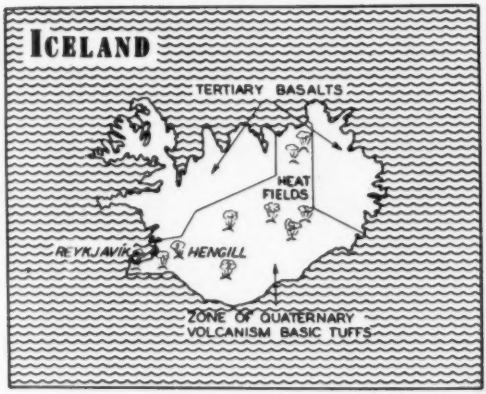
Drilling for HEAT in ICELAND

by Gunnar Bodvarsson



Location of "heat fields" in Iceland. Hengill field contains a heat value equivalent to 70 to 700 million barrels of oil

DRILLING for heat in the form of steam is one of the most novel of the many uses to which rotary and cable tools have been applied; allied with this enterprise is the drilling of hot-water wells. This unique activity is taking place in coal and oil-short Iceland, an island which has an immense amount of subterranean thermal energy, stored in the form of hot water and steam, which is evidenced at the surface by hot springs and fumaroles (steam holes).

Exploratory wells down to a depth of 1,000 ft. have been drilled with core-drilling machinery, using diamond and steel-shot bits. The diamond bits generally make 10 to 25 ft. in a 12-hour day in basaltic rock. The most economical method of drilling shallow steam wells is the cable-tool method. Several wells producing low-pressure steam or steam-water mixtures have been drilled by means of this method. The wells are 100 to 500 ft. deep and in most cases just drilled into the producing zone.

Only surface casing of 6 to 10-in. size less than 100 ft. in length has been run into the wells, which produce 5 to 15 tons per hour of steam at 5 to 10 psig. The static or shut-in pressure is 30 to 70 psi. The drilling rate is variable, owing to the many difficulties in handling the equipment in the presence of boiling water and steam. Some of the wells have been completed in several days, but the deeper ones have required many weeks or even months to complete. The cost of steam from these wells, due to high depreciation rates, is about 2 to 4 cents per 1,000 lb., which however, is a very low price in a country where the price of coal is nearly tenfold that in the United States.

Development of Heat Fields

Use of a modern rotary seems at this moment probably the most economical and efficient method of drilling wells for large-scale production of steam. Evidently wells more than 1,000 ft. deep and having an inner casing not smaller than 8 in. are required. To achieve efficiency, casing must be run to the producing zone and should be corrosionproof.

There are now about 90,000 ft. of hot-water wells in Iceland. The greatest portion of these have been drilled for the hot-water supply of Reykjavik, the Icelandic capital. This drilling was performed between 1933 and 1947 about 10 miles from the city where there are some 45 wells of 4 to 8-in. size and 450 to 2,400 ft. deep, producing 4,200 g.p.m. at a mean temperature of 188° F.

The initial flow of the springs in this locality was 1,600 g.p.m. at 179° F. The unique municipal hot-water supply plant of Reykjavik supplies the hot water through a single pipe system without heat exchangers, for domestic heating for some 30,000 inhabitants. With very few exceptions, hot-water wells in Iceland have been drilled by core-drilling machinery of the same kind as used for the aforementioned exploratory wells at the fumaroles.

The methods of prospecting for natural steam in Iceland are based on the aforementioned fundamentals. Studies of geology, underground temperatures, and permeability comprise the most important work. Geophysical exploration by magnetic methods has been of importance in the locating of faults and dikes, and the electric-resistivity methods have been useful in the study of underground temperatures, the latter first introduced in 1947.

These shallow wells which are used for heating purposes are inadequate for the large-scale generation of electricity, as for this purpose wells of higher pressures and production are required. It is at this moment not clear whether it will be possible to generate electricity in Iceland by natural steam at lower prices than by hydropower which is also abundant in the country, but it is planned to investigate the possibilities of two "steam fields" in the neighborhood of Reykjavik and one of these is Hengill field.

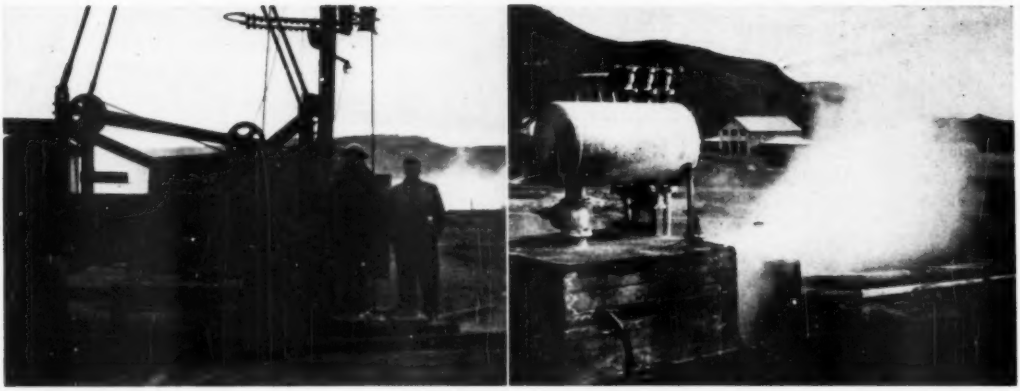
Drilling for hot water has been performed in Iceland since 1928, when Steingrimur Jonsson, director of the

The Unusual in the Drilling Business

Each year in this special issue devoted to Drilling Contractors and Equipment, The Oil and Gas Journal makes a point of presenting one or more articles about the "unusual" in the drilling business. For example, two years ago the Journal told how Camay Drilling Co., of Compton, Calif., shipped a small rotary to the island of Hawaii and set it up in a mine chamber 460 ft. below the ground—to drill for water, a scarce and valuable commodity in the area. Hole sizes of the subterranean wells were 17½ to 30 in. in diameter, the holes 300 to 750 ft. in length. This underground drilling was made necessary by the proximity of overhead lava formations and circulation problems.

In last year's issue, the Journal published a special article on "Drilling Contractors Go to Sea" which gave a complete roundup of the pioneering work of the first group of contractors in their new offshore operations in the Gulf of Mexico.

The article at hand may set a new high for describing the "unusual" that can be done with drilling tools. . . . In recent years in Iceland, over 90,000 ft. of shallow hot water wells have been drilled. . . . The hot water "production" is pumped 10 miles through a single pipe-line system to supply domestic heating for the Icelandic capital of Reykjavik, a city of 30,000 inhabitants. . . . Exploration work has disclosed there are many "heat fields" in the country. . . . In one area underground temperatures rise to more than 600° F. at depths of 1,000 ft. . . . And calculations of surplus heat show that within a depth of 3 miles there are 40 to 80 quadrillion B.t.u. accumulated. . . . This is equal to the heat value of 6 to 12 billion barrels of petroleum.



Left: One of the cable-tool rigs used in drilling the heat fields. Driller wears a rubber overcoat for protection. Right: Steam water separator on a completed steam well

municipal electricity works of Reykjavik, and Thorkell Thorkellsson, a scientist well acquainted with thermal activity and known for his work in that field, started the first drilling. The work of these two pioneers has been of great value in later developments.

The superheated water in the rocks behaves in many respects as petroleum which holds natural gas in solution, i.e., the boiling point of the water corresponds to the bubble point of the petroleum. Suppose a well is drilled into the hot rock and that the boiling point of the water at the corresponding pressure of the ground water be approximately reached at a certain depth. At the depth where the pressure of the water column is less than the boiling pressure of the water, the well becomes unstable and blows the column out.

If the permeability of the rock exceeds a certain minimum the well will be able to continue the production of steam and water from fissures and pores in its vicinity. The forces responsible for the expulsion are just as in the case of petroleum: (1) the expanding force of the steam, (2) the force of gravity from the buoyant force of the encroaching heavier cold water, and (3) the force of gravity by hydrostatic head.

Production Mechanics

This process very probably follows the same lines as the expulsion of petroleum from the reservoir rock provided that the permeability be favorable, only with the remarkable difference that its most important source of energy is the heat accumulated in the rock. By assuming that the heat input from the intrusive is of the same order as the heat dissipation at the surface, i.e., equal to some 5 to 10 tons of steam per hour per square mile, one finds that this is much too little to be of any importance, and therefore every major well must at last get its energy from the heat storage.

A blowing well takes water from the steam field and consequently more encroaching water enters it, but this water is heated by the contact with the hot rock and thus is able to contribute to the process. In fact, drilling increases the circulation of water, which again drains the surplus heat in the rock. Each cubic foot of rock at 550° F. is, by cooling to 300° F., able to heat 35 lb. of water from 32° to 300° F., or produce about 8 lb. of steam at 300° F. and 70 psia.

"Heat" Reserves and Costs

It is difficult to predict anything about the ultimate percentage recovery from the "heat field" available by means of well drilling, but are figures such as 1 to 5 per cent very unreasonable if conditions as permeability, temperature, etc., are favorable? This would indicate that one should probably be able to recover 4.10^{14} to 4.10^{15} B.t.u. from Hengill field (see cut) at a temperature of 300° F. This is equal to the heat value of some 70 to 700 million barrels of oil, i.e., Hengill heat field is in this respect comparable to the major oil fields.

The production costs of 1,000,000 B.t.u. from certain oil fields are now some 15 to 30 cents, but as shall be mentioned later, the same costs in the case of the heat field have been some 8 to 15 cents, i.e., it is in this respect not inferior to the oil field. But the heat field has two very serious defects, i.e., firstly, one isn't able to transport the heat from it in the same economical manner as is possible in the case of the oil field. This is, in fact, a most serious drawback which renders the production of heat from 8 to 9 out of 10 fields in Iceland uneconomical. Secondly, the heat fields are producing low-temperature heat which is only 25 to 40 per cent as efficient for power generation as heat from petroleum.

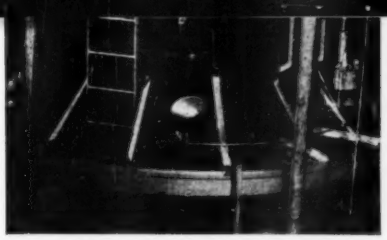
Hot springs and fumaroles (steam holes) are abundant in Iceland. In fact, only three regions—Yellowstone National Park, Tuscany in Italy, and Rotorua in New Zealand—have thermal activity of comparable magnitude. About 600 hot springs, having an integrated discharge of 25,000 g.p.m., and a mean temperature of 167° F. computed from the total heat dissipation, are found in the country. The integrated flow of the fumaroles is estimated to be 300 to 500 tons of steam per hour.

In the central and southern regions, i.e., the regions of Quaternary volcanism, fumaroles are found in 10 localities. One of the most active is the Hengill region, some 30 miles off Reykjavik, where fumaroles and hot springs are found within an area of 30 sq. miles. Conditions in this region have been studied during the last decade and some exploratory and steam wells have been drilled.

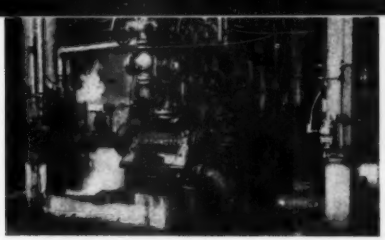
Measurements of underground temperatures near to the fumaroles in one part of the region have indicated more than 400° F. at depths of 600 ft., and probably up to 600° F. at depths greater than 1,000 ft. There are good

The Author

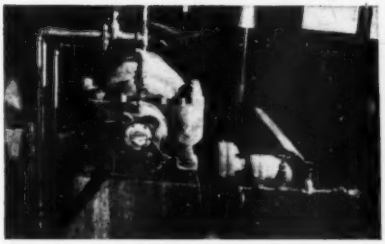
Gunnar Bodvarsson was born in Iceland and attended universities in Sweden and Germany. In 1945 he entered the services of the State Electricity Authority in Reykjavik, Iceland, where he was engaged in the supervision of the drilling and geophysical activities of this institution. In 1946 he was appointed engineer in chief of the Geothermal Research and Drilling Department.



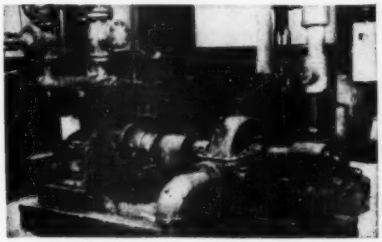
Worthington deaerating feed water heater



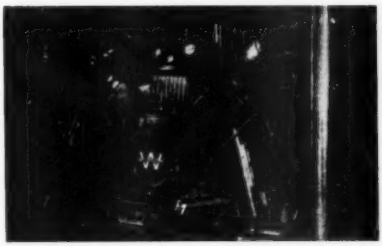
Worthington HiVol reciprocating pumps



Worthington feed water pump



Worthington-Moore turbine-driven pump



Worthington air compressor

Worthington rotary asphalt pumps

Most Everything Here Is Moved By Worthington

Worthington equipment plays an important part in handling water, air, crude oil and refined products at the refinery of a large independent in the Chicago area.

Water for cooling purposes is pumped, in tremendous quantities, from a large canal to the refinery by a Worthington circulating pump, a Type 16-LA-2, driven by a 250 hp motor. It supplies 7000 gpm against a 120 ft head, and has been doing this for more than 10 years, 24 hours a day, without shutdown except for normal maintenance.

In the boiler room, feed water is preheated to almost 250 deg. before entering the boiler by a Worthington deaerating feed water heater. The present heater of the steam jet type was purchased a year ago to remove oxygen from the water in order to lower corrosion in the boiler tubes. It is rated at 225,000 pounds per hour, and replaced a Worthington Type N6 which had been used for 15 years and was still in perfect condition but not of large enough capacity to meet the new conditions.

At the same time, a new boiler feed pump was installed to take care of the added capacity. It is driven by a 125 hp motor and furnishes 500 gpm against a 600 ft head.

Compressed air to operate power tools and instruments is furnished by two Worthington Air Compressors purchased 15 years ago, and a new Type YC2 with 798 cfm capacity was added to the group in 1945 and has been been running continually since then.

To drive oil through the stills, a centrifugal hot oil charge pump is used. It is driven at 3600 rpm by a Worthington 450 hp condensing steam turbine and is serviced by a Worthington barometric condenser.

This unit replaced an old Worthington reciprocating plunger type pump which had been purchased in 1931. The old plunger type was over 40 feet long, compared with 10 feet for the turbine type.

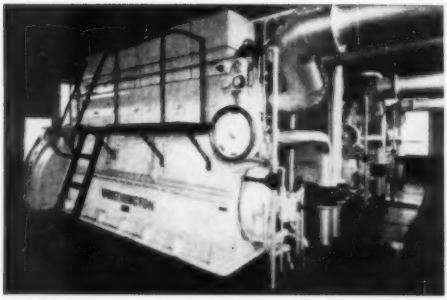
Cracked gasoline is pumped to the stabilizer by a Worthington-Moore turbine-driven pump, 1300 lb on suction side, 325 lb on discharge. This pump is unique in that it has a mechanical seal which has eliminated packing scoring with its subsequent leaking, and consequently it requires much less maintenance and runs longer without shut downs.

Three Worthington HiVol reciprocating steam pumps are used in the production of propane. The 18x8½x18 pumps the impure LPG into the depropanizor tower; the 12x8x18 reflux pump is part of the control of the process on the tower; the 10x6x12 is used for standby duty.

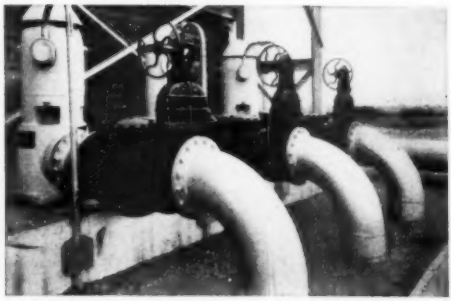
Two Worthington type 6-GR rotary asphalt pumps, driven by 40 hp motors, circulate the asphalt from the storage tanks through a heater and back to the tank to prevent the asphalt from solidifying. They are also used to pump the asphalt into tank cars and tank trucks.

NEWS

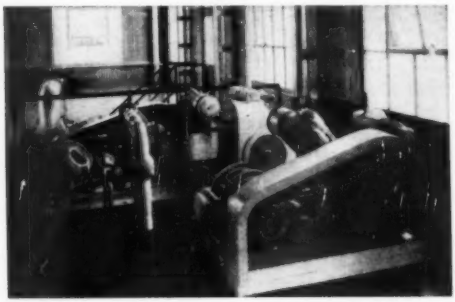
FROM THE PETROLEUM FRONT



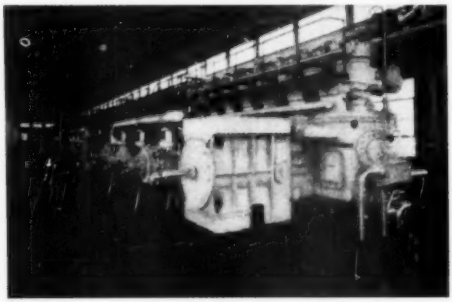
Three Worthington auxiliary engines in gas compressor station at Tennessee Gas Transmission Co., East Bernard, Texas



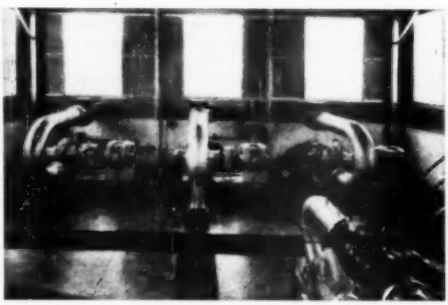
Worthington vertical turbine pump circulating water over cooling tower in main line gas compressor station at Tennessee Gas Transmission Co., East Bernard, Texas



Worthington Air Compressors for starting engines in main line booster station, Tennessee Gas, East Bernard, Texas



Eleven Worthington compressor engines in main line compressor station, Tennessee Gas Transmission Co., East Bernard, Texas



Worthington 10" water pumps handling jacket water to auxiliary engines, Tennessee Gas Transmission Co., East Bernard, Texas

Five Jobs For Worthington At Tennessee Gas Transmission Company

The East Bernard, Texas plant of the Tennessee Gas Transmission Company is now using Worthington vertical turbine pumps, gas compressors, gas engines, starting air compressor units and centrifugal pumps to handle natural gas in the pipe lines from South Texas to West Virginia.

All this equipment was installed in 1944, and has been operating satisfactorily since that time. Three vertical turbine pumps circulate the cooling tower water over the cooling tower in the gas pipe line compressor station. Similar pumps are used at station No. 4 at Jasper, Tex., station No. 6 at Monroe, La., and station No. 7 at Greenville, Miss.

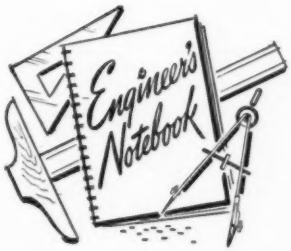
Eleven compressor engines in the main line station, the second compressor station on this gas pipe line, handle approximately 360,000,000 cubic feet of natural gas per day.

Three CCF-6 Worthington gas engines drive Westinghouse generators for supplying electric power for gas pipe line compressor station.

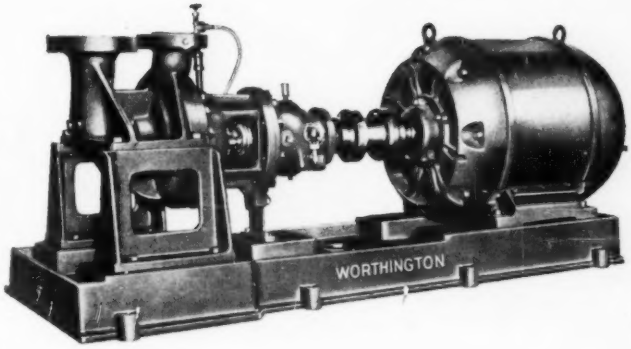
Three 12LA-1 60 hp centrifugal pumps and two 6L-1 25 hp centrifugal pumps supply jacket water for cooling gas engine driven pipe line compressors. Similar pumps are also installed at stations No. 4 at Jasper, No. 6 at Monroe and No. 7 at Greenville.

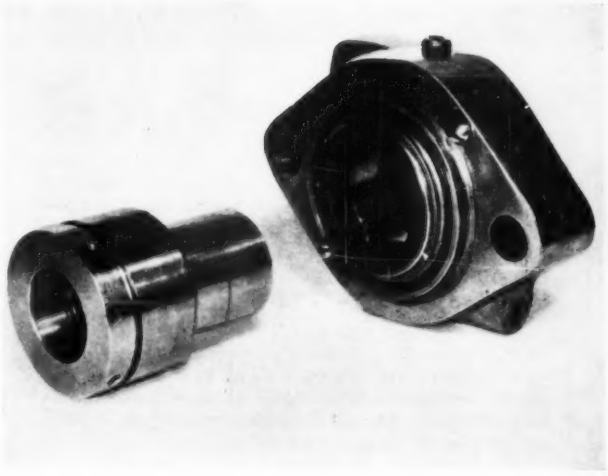
Worthington Pump and Machinery Corporation
Harrison, N. J.

NEWS



Mechanical Seals for Centrifugal Refinery Pumps





Because satisfactory stuffing box operation is necessary for a successful pump operation, Worthington has spent several years investigating the problems presented by high pressures and non-lubricating liquids now common in the petroleum refining and petrochemical industries.

The result of this investigation is the development of a single mechanical seal to be used in the stuffing box of process pumps handling light hydrocarbons at high pressures.

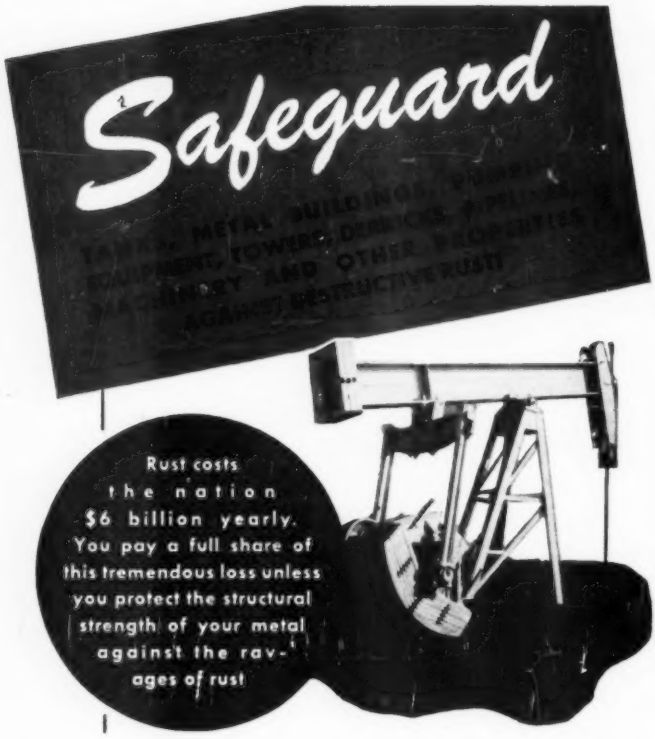
The first objective in Worthington's development work was to eliminate the costly seal oil system and the frequent replacement of conventional packing. At the same time, it was decided to keep the mechanical seal as simple as possible so that it could be installed, operated and maintained by normal refinery personnel at a minimum of cost.

This has been accomplished by making the rotating element a simple, streamlined assembly—as shown in the picture.

It is streamlined to eliminate churning in the liquid and has been symmetrically designed so that vibration at any speed is eliminated. The stationary element provides the necessary flexibility for a seal of this type and is an assembled unit that requires no adjustment on the pump, or during the assembly of the pump and seal. The materials used for the rotating and stationary seal faces are such that friction is reduced to a minimum and by incorporating hydraulic balance, long life is assured.

Single mechanical seals eliminate the possibility of contamination of product with seal oil and make it unnecessary to use high pressure seal oil pumps with control valves. Auxuliary packing glands can be furnished where safety requirements make it mandatory to control closely the vent vapors.

The type G mechanical seals are installed in Worthington refinery type process pumps as optional equipment for pressures up to 500 psi and temperatures up to 250 deg. F. Interchangeability is kept at a maximum by using three sizes of seals for 24 different sizes of process pumps. Modifications can be made in these seals for higher pressures and temperatures. The same general design of seal is used for high pressure, high speed pipeline pumps where continuity of service is an important factor, and where leakage is expensive and highly undesirable.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reasons to believe that similar abnormal temperatures are found within a great portion of the region, i.e., a great part of the subterrain of 30 sq. miles is heated to elevated temperatures.

Having regard to the normal temperature gradient it is easy to compute the amount of surplus heat in the rocks of this region, and one finds that within the depth of 3 miles there are 4.10^{16} to 8.10^{16} B.t.u., accumulated, 75 per cent of which are probably present at higher temperatures than 300° F. **This is equal to the heat value of 6 to 12 billion barrels of petroleum.**

The steady heat dissipation of this heat field to the air through hot springs, fumaroles, and regular conduction is estimated to be about three times the heat dissipation of the fumaroles alone, which are blowing 50 to 100 tons of steam per hour, i.e., the heat dissipation of the field is 350 to 700 million B.t.u. per hour. This heat flow would require about 10,000 years to be able to account for the amount of heat stored in the rock.

Source of Dry Steam

Dry steam is more valuable than a steam-water mixture as the water greatly decreases the steam production capacity of the well; it is thus of great importance to know where there are possibilities of getting dry steam. This can be the result of (1) a partial or complete evaporation of the circulating water, either through a sufficient heat flow and temperature, or through the release of pressure on the way to the surface which very probably is the steam source of the fumaroles, (2) the separation of water and steam by gravity, which is of particular importance where there are possibilities for the accumulation of the steam within structures, (3) the expulsion of the juvenile steam from the intrusive, but this seems to be of little importance. Furthermore, factors such as the relative permeability ratio of steam to water are certainly of importance for the separation process.

Hot Spring Location and Causes

Many of the hot springs are, contrary to the fumaroles, found in the regions of the Tertiary plateau basalts, where the hot water in most cases issues from faults or dikes. In 1942, Trausti Einarsson, professor of University of Iceland, published a report on his investigations on the hot springs in northern Iceland, wherein he argues that these have no connection with volcanism, i.e., intrusives, as previously assumed by students of thermal activity in Iceland. His important arguments, which are not less physical than geological, have received further support from later research, and one must regard this step as the most important towards the clear understanding of the mechanism of the hot springs.

The main cause of the hot springs must be sought in the unique hydrological properties of the basalt plateau, which with its many lateral contacts and vertical dikes and faults is making a deep circulation of surface water possible where convection currents are an important factor. Besides the normal temperature gradient, the following factors can contribute to these currents: (1) topographic irregularities have both thermal and hydrological influence, (2) the very rapid denudation of the plateau during the Pleistocene has an effect on underground temperatures which in many places may still be a good deal higher than normal. It is well known that underground temperatures require very long periods of time in order to adjust themselves to the new shape of the surface, (3) the

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average temperature gradient may in Iceland be higher than on the continents.

In the case of the hot springs, only small volumes of rock have been heated by the water, and their temperature is not far from that of the springs, i.e., the "hot water fields" are therefore not heat fields in the same sense as in the case of the fumaroles. The main purpose of well drilling around the hot springs is thus to gather the hot water which flows from below, this being carried out by cutting the hot-water-bearing fissures with the wells. These gather the water which flows to surface springs or loses its heat near to the surface through conduction and mixture with cold water. It is possible that the drilling is in some cases able to increase the whole flow from below, but no substantial increase can be expected. The increase of flow through a local convection through hot rock is probably only possible in a few cases and will last only for a short time, but it is of practical importance to take this into consideration as some wells may for this reason only have a short life.

Iceland's Geology

Volcanic activity is the predominant factor in the geology of Iceland. The main formation of the country is a plateau, made chiefly of basaltic lavas—hundreds of them, piled one above another, having a total thickness of probably more than 10,000 ft. This plateau seems to be a remnant of a much greater one, which in Tertiary time covered the North Atlantic region from Greenland to the British Isles.

The oldest lava flows are probably of Eocene age, but the volcanic activity has continued in Iceland up to this time, making it one of the hottest spots in the world. The plateau is depressed in the central and southern regions and covered by thick formations of tuffs of Quaternary age. In the coastal regions in the West, North, and East it rises 2,000 to 5,000 ft. above sea level. It is heavily faulted and cut by a great number of basaltic dikes. The basement is unknown, but it is not improbable that Mesozoic or even Paleozoic sediments may lie beneath.

Heat Sources

One can hardly escape the conclusion that the aforementioned conditions are created by a magmatic intrusive, the depth of which cannot be more than 2 or 3 miles. Having regard to the duration of the thermal activity in the region, which no doubt is many thousands of years, and to the heat accumulated, one finds that this intrusive must be of a size of more than 10 cubic miles, i.e., it is most probably a stock. Using reasonable values for the water contents of the magma one furthermore finds that juvenile (magmatic) water can only be of little importance as a heat source of the fumaroles.

The occurrence of the fumaroles within areas of very young basic tuffs is conspicuous, and suggests a certain relation between the genesis of the tuffs and the fumaroles. The parent magma of the tuffs is perhaps the material forming the intrusives, which are acting as heat sources of the fumaroles. The natural steam generally contains a few per cent of gases, with carbon dioxide the chief constituent, accompanied by small amounts of hydrogen sulfide, methane, and hydrogen. These gases are often considered to be volcanic but they can just as well be derived from other sources.

It can be shown, provided the permeability of the country rock is appreciable, that every large magmatic intrusion at moderate depths will cause strong convective currents in the ground water within the roof rock. It is, in this connection, important to note the rapid decrease of the density and the viscosity of water with increasing temperature, e.g., at 500° F. the density is 78 per cent and the viscosity only 6 per cent of the values at 32° F. Thus the heat of the intrusive goes through conduction to the circulating water which again brings it to the surface and the surface rocks.

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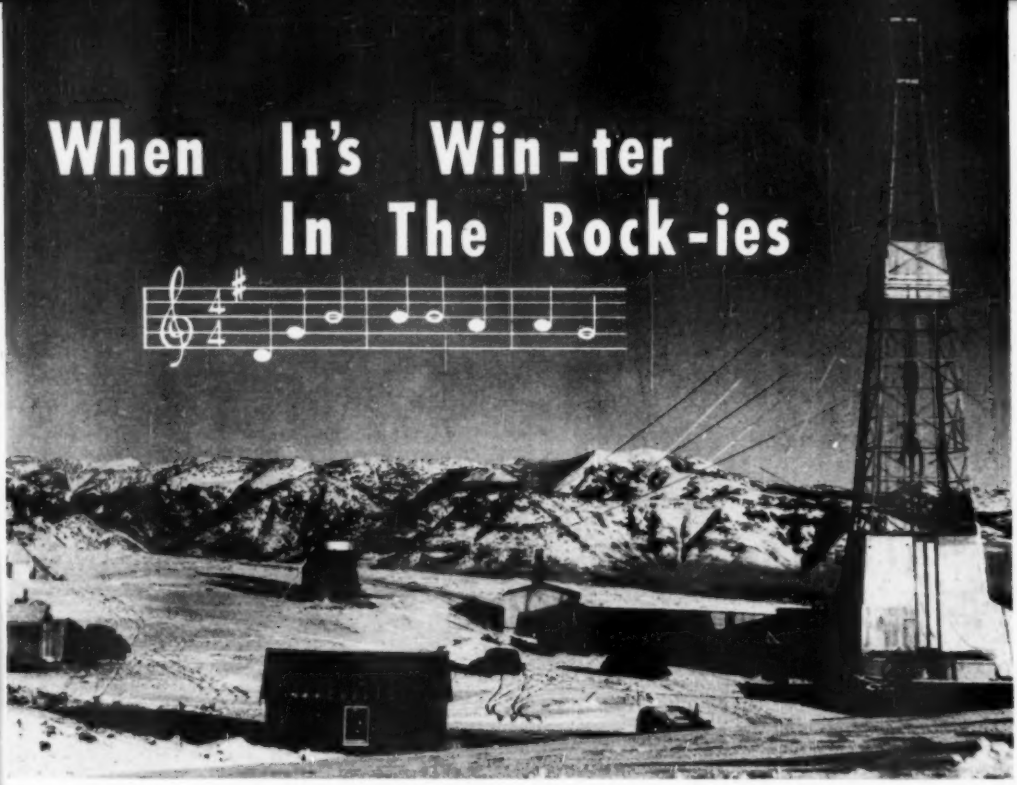
When It's Win-ter In The Rock-ies



CAREFULLY PROTECTED WINTER DRILLING OPERATION.—Rig of Fred M. Manning, Inc., at work on Continental Oil Co. 1 Afton, Lincoln County, Wyoming. Location is 8,244 ft. above sea level and photograph was taken prior to the deep snows. Before the winter season was over snowdrifts were 20 ft deep. (Photo courtesy Everett J. Reaser, division drilling superintendent, Continental Oil Co.)

Extra equipment must be used and added precautions taken during winter operations anywhere in North America, but it is in the Rocky Mountain area that this problem assumes major proportions. Here these additional facilities and techniques are of paramount importance to effective operation of personnel and machinery. Winter drilling has developed and improved with improvements in basic drilling machinery, and are now a complex phase of drilling operations in the area.

To better describe and discuss the various drilling methods the accompanying report was prepared for discussion of the American Petroleum Institute's Rocky Mountain district subcommittee on drilling practices. This report was presented by C. H. Griffin, Phillips Petroleum Co., Casper, Wyo. A list of the subcommittee members—instrumental in obtaining solutions for these drilling problems—is also given.

I. ROADS, TRANSPORTATION AND COMMUNICATION — Probably the most difficult phase of winter operations:

A. Roads—for transportation of heavy equipment as well as personnel and supplies—must be built to serve when frozen, snow covered, or thawing.

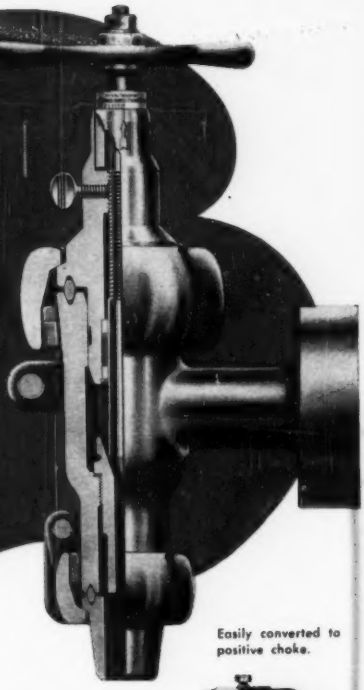
1. When planning roads, efforts should be made to stay in the flat insofar as possible to avoid heavy drifts and prevent trucks from having to attempt inclines when the road is icy. This may mean longer roads than normal, but invariably it pays out. Roads constructed on the level should be elevated from 2 to 3 ft. with wide flat bar pits in order that the wind will blow them clean. Snow fences which can be purchased at lumber yards are very helpful through shallow cuts and of course gravel and culverts will generally be necessary in the low places during thaws. A 16-ft. road is considered to be most economical along the flat in order to allow room to dispose of snow, allow room for passing, and facilitate drainage. High crowns should be avoided because of difficulty of keeping trailers on the road when icy.

2. Mountain roads should be built along ridges wherever possible where the wind will keep the snow cleared and ample drainage is provided. Mountain roads where deep cuts are necessary give continuous trouble with snow drifts and snow fences have been found to be practically no help. Bulldozers are generally required to keep these roads open; though U. S. Army "weasels" have proved excellent for transporting personnel and supplies over drifted snow. Rotary snow plows such as the "Sno-go" are particularly helpful in clearing drifts between two banks where bulldozers would otherwise have to push the snow very high or over extended distances.

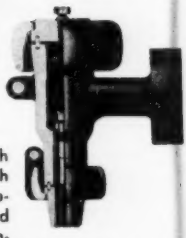
B. Wherever locations permit landing by plane, expensive road clearing can sometimes be avoided by using aircraft to change crews, as well as to bring in supplies. A ski-equipped plane was used at South Cole Creek last winter very successfully until the wind cleared too many bare spots in the strip. However, aircraft are unreliable in stormy weather and should be used only as a last resort. Horses as well as jeeps have also been used for transporting men and supplies and under some circumstances might save considerable road-clearing expenses.

C. Adequate communication is always of prime importance in drilling operations and even more vital in wintertime when unforeseen emergencies are most likely to arise. Consequently it is felt that if it is at all feasible to install a telephone at the rig it may save a great deal of time and money. If phones are impractical,

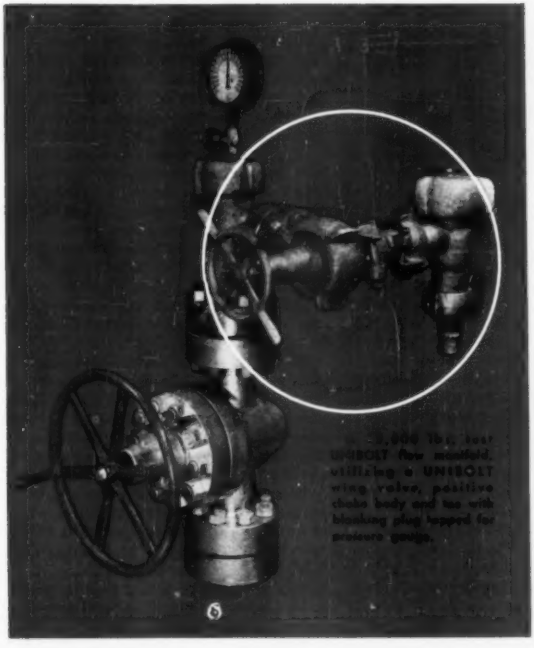
THE *New* Unibolt WING VALVE



Easily converted to positive choke.



IS BETTER THAN EVER BECAUSE IT'S *"free-wheeling"*



The UNIBOLT WING VALVE, which is popular with production men both as a Christmas tree wing valve to provide a shut-off for choke changing, and a dependable, convenient and inexpensive long-life adjustable choke where well conditions permit, has again been improved. Note in the cross-section view presented above how the stem packing is arranged to eliminate the need for further tightening after the valve is assembled at the factory. Adequate sealing compression is applied to the packing to assure a pressure-tight seal yet permit the stem to turn freely in the packing—"free wheeling". Both the quality of the packing and the mechanical design of the packing compression assembly have been carefully selected and engineered to assure long service and easy operation.

The numerous mechanical features which have distinguished UNIBOLT WING VALVES, such as the use of UNIBOLT Couplings to assemble the component parts of the assembly, complete interchangeability of all parts, self-centering stem, adequate flow area to provide non-restricted flow when used as a wing valve in a positive choke manifold, precise calibration, etc., have been retained.

Available in 6,000, 10,000, and 15,000 lbs. test, and in corrosion-resistant alloy.

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HOUSTON, TEXAS

WINTERIZED RIG ON WORLD'S DEEPEST WELL (20,521 FT.).—View of Superior Oil Co.'s giant rig at 1 Pacific Creek Unit, Sublette County, Wyoming, 7,087 ft. above sea level. Insets show bulldozer used to clear heavy snowdrifts around rig, and Army "weasel" used for transporting drilling crews over deep snow. (Photos courtesy Ken's Photo Shop, Casper, Wyo.)

the use of walkie-talkies or other short-wave radio equipment seems to be well justified.

II. WATER, FUEL, MUD, AND UTILITIES—Under reasonable conditions these facilities can be handled satisfactorily under winter conditions.

A. Water supply must receive careful attention.

1. A water well located near the rig is by far the best supply if properly housed and protected. It will generally operate satisfactorily at 40° to 50° below zero.

2. A water hole or dammed-up stream is satisfactory if reservoir is 8 to 10 ft. deep. Shallow holes and small streams will invariably freeze solid. Booster pumps at the source should be housed with adequate heating facilities available.

B. Pipe lines from the source to the rig should be buried 6 ft. deep if installation is to be permanent. Otherwise 4-in. invasion pipe with Victaulic couplings laid on top of the ground makes an excellent water line; for plenty of quick couplings allow the line to be thoroughly drained each time after its use. Also short sections of frozen line can be readily replaced if firing does not properly thaw them out or if firing is not possible. During the relative few days when the temperature is lower than 30° below zero or during the very coldest hours of the night and early morning, pumping water should be avoided if possible.

C. To provide ample water for emergencies a 1,000-bbl. water-storage tank should be provided as close as possible to the rig. The cost of this larger-than-normal water-storage tank will pay out quickly if a shutdown due to water shortage can be thus avoided. One thousand barrels should be about a 5-day supply at normal rate of usage or would provide enough water to mix a large quantity of drilling mud in the event of an emergency.

1. Water lines from tank to rig should be as short as possible and laid on top of ground with plenty of quick couplings to allow ready drainage after use. They should be laid along a steam line if possible and insulated together.

2. All water lines around the rig and to the pits should also be adjacent to steam lines.

D. Fuel supply is of vital importance in winter operations and storage facilities for at least a 5-day supply of liquid fuel are a must. Any lesser amount will probably result in expensive road-clearing operations to keep the rig going.

1. Diesel fuel is relatively trouble free in cold weather.

2. Butane tanks and propane tanks should be kept heated with steam coils to maintain pressure and prevent freezing in the lines.

3. Fuel-gas lines have to be kept free of water-vapor condensates and drips should be steam heated to prevent freezing.

E. Rotary drilling mud can be handled fairly well in the coldest weather, primarily because of the heat absorbed from the earth.

1. Housing over the mud pits is desirable to facilitate such operations as mixing, treating, and testing.

2. The amount of storage required is difficult to specify because of differing hole conditions. Normally a 5-day supply should be maintained, but if lost circulation is anticipated, an ample surplus would prove a good investment because of the difficult transportation problem.

III. PROTECTION OF RIG AND EQUIPMENT—Considerably more extensive than normally required:

A. Rig covering of corrugated galvanized iron has proved more economical than sheet aluminum or canvas because of its durability to wind, weather and hard knocks.

1. Rigs should be tinned to the third girt and enclosed around the substructure, otherwise drifting snow will cover up control heads, underfloor piping, and similar equipment.

2. Engine houses should be large enough to cover mud pumps, pits and mud storage in order to utilize the heat from the engines in all of the important working areas, and in addition must be well heated with steam coils throughout.

3. Tin around the derrick man's position is essential to shelter the man as well as the equipment from excessive snow and ice.

B. Steam lines should be well placed around the rig to give heat to all water lines, draw works, control head, mud lines, pumps, and other points subject to freezing, particularly under the derrick floor by the brake-cooling system and the hydromatic tank.

1. An ample supply of steam is an absolute necessity and a boiler of at least 70 hp. should be used. The boiler should be insulated and housed at least around the controls in order to conserve fuel and allow the boiler to be operated under the most extreme conditions.

2. Steam hoses should be provided for cleaning the rig and machinery and thawing out frozen points such

as tool joints, water lines, mud suctions, etc.

C. Open fires are generally used where insufficient steam is available for heating the working area and thawing out frozen lines.

1. Open fires have the advantage of being readily available and quickly effective.

2. They have the serious disadvantage of constituting a major accident hazard to property and personnel and it would be desirable to eliminate their use wherever possible. Open fires, especially oil fires, are also dirty and will quickly smoke up the engine house and cover the tools and machinery with soot to the extent that operations are seriously impeded.

D. Special provisions should be made for easily draining all mud and water lines to prevent freezing when idle.

1. Main mud line and standpipe should have outlet to pits.

2. Rotary hose is generally disconnected at the swivel and drained on the floor.

3. The kelly and swivel must be carefully drained and steam coils located at the top of the rat hole to prevent the kelly from freezing in the ground.

4. The fillup line must also be carefully drained after use in order to make sure it will be in operating condition when needed.

E. Lubrication of machinery is difficult in very cold weather and additional precautions have to be taken to avoid serious breakdowns.

1. Lubricating oils refined for winter use should always be specified.

2. Oil drums should be stored in the engine house or other shelter to keep them fluid.

3. As long as machinery is kept running oils will not be a problem, but when left idle the lubricant will congeal and the machinery will likely be impossible to start if colder than 15° below.

4. Engines left in the open should be drained after usage and crankcases flushed. On starting them again warm oil to 180° F. before filling the crankcase to avoid damage to the engine.

IV. PROTECTION OF PERSONNEL—Provisions must be made to allow workmen to carry on operations efficiently despite extreme cold and adverse conditions:

A. The conventional change house is generally suitable if provided with additional heating facilities and located adjacent to the derrick floor.

1. An additional bunk house about 8 by 20 ft. equipped with two double-deck bunks, washing facilities, cook stove, and heating facilities will make it possible for the crew to get along all right when roads cannot be kept open and crews changed regularly. An ample stock of staple foods and canned goods should be kept on hand in order to be able to withstand a prolonged storm. The amount of provisions is dependent on the location of the rig with respect to the nearest point of supply.

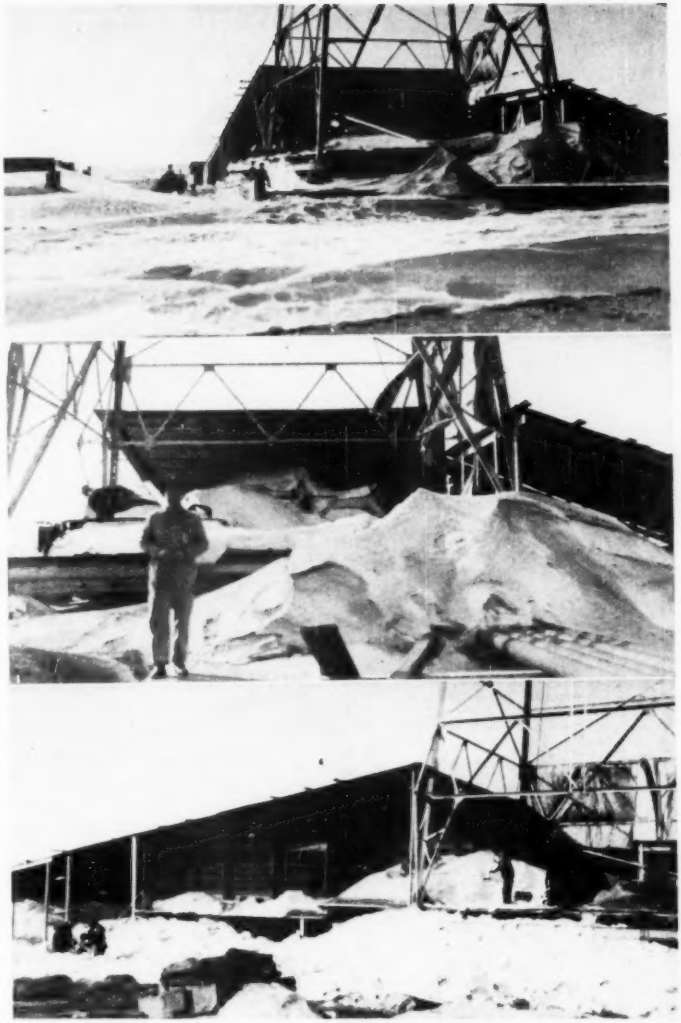
2. On exploratory wells a house trailer is generally provided for the geologist and is usually available for the drilling foreman as well.

B. Special heating facilities should usually be provided for the men at the various working positions.

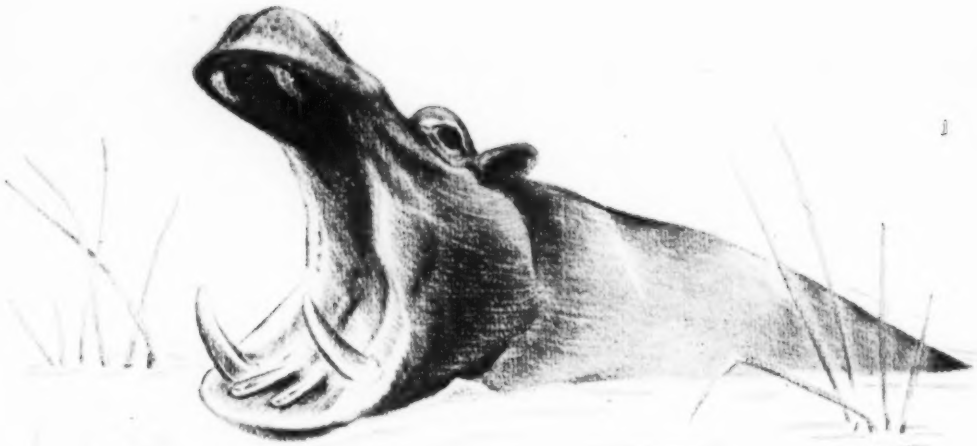
1. At the driller's position a steam coil backed with tin should be located so that the driller can remain at the brake with reasonable warmth. The coil should be connected with quick couplings or flexible pipe so that it can be easily moved out of the way when necessary.

2. Steam coils and a small shelter about 30 in. square should be provided for the derrick man in order that operations may be carried out during extreme weather.

3. Some operators have provided U. S. Air Corps electrically heated flying suits for the derrick man and these should prove excellent because of their light weight and ample warmth. A special 24-volt generator driven by a gas engine or electric motor provides the necessary current without danger in the event of electrical short or other power trouble.



SNOW SCENES AT WORLD'S DEEPEST PRODUCING LEASE.—View of Lotland Bros. Co. rig at Pure Oil Co. 3 West Poison Spider, Natrona County, Wyoming. Crews were in process of rigging up when snowstorm struck—were unable to get to rig for period of several weeks. (Photos courtesy A. E. Chandler, Casper, Wyo.)



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Use of dry transformers is considered hazardous.

4. Steam lines around the derrick floor are helpful but not essential.

V. SAFETY IN WINTER OPERATIONS—Accident hazards are much greater in cold weather:

A. With the common use of fires around the rig, accidental fires must be continually guarded against.

1. All workmen should be continually warned against carelessness.

2. Ample blowout-protection equipment should be installed and maintained in perfect working condition. Pressure-operated rams are the most satisfactory.

3. Fire extinguishers (CO_2 type or equivalent) should be placed in the change house, engine house, and on the derrick floor. Steam hoses should be located conveniently and kept in good condition for emergencies.

B. Accidents with tools are always more frequent when hands are cold and machinery is icy.

1. First-aid kits should be kept handy at all times and always well supplied.

2. Medicines for burns are extremely important in the first-aid kit.

C. Walkways, stairways, and working floors should be kept clean of ice and lightly sanded at all times.

1. Accidents resulting from falls are likely to be serious and stretchers, splints, and blankets should be kept with the first-aid supplies.

2. Because of the difficulty of getting a man to the hospital when roads are snow covered, every safety precaution should be practiced at all times.

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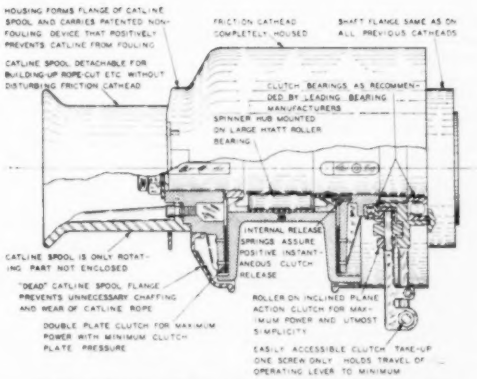
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APPLICATION OF

Hydraulic Drives

TO OIL-FIELD EQUIPMENT

by Nicholas A. D'Arcy, Jr.

MANY unusual operations can easily be performed with rigs equipped with hydraulic drives. Gyrol drives allow the operator to vary the speed of his slush pump and to hold a strain on drilling line when fishing or endeavoring to move stuck pipe. Hydraulic torque converters have added flexibility due to the fact that they have the ability to multiply the engine torque when conditions require.

Flexibility of the drive equipped with hydraulic torque converters allows the operator to obtain a desirable type of operation on a fishing job. If he wants to maintain a constant stalled-line pull he can do so by setting his engine throttle at the speed that will result in this pull. Should the fish loosen, the converter will automatically speed up and lift the load until it might again become stuck. This provides the equipment with the automatic ability to take advantage of any loosening of the fish and also prevents overloading the equipment beyond a desired point.

If the pipe becomes stuck and the operator desires to work it up and down the hole, he merely engages his clutches and controls all future operations with the throttle. By opening the throttle the load will be lifted at a rate of speed depending upon the degree to which the throttle is opened. Slightly closing the throttle would hold the pipe stationary in the hole and further closing the throttle would allow the pipe to descend. This opening and closing of the throttle with its resulting raising and lowering of the pipe can be carried on for hours without damage to any portion of equipment.

Special-Service Pumps

Special-service reciprocating pumps also take full advantage of the characteristics of hydraulic torque converters. Some special-service pumps are designed specifically to break circulation or to reverse circulation into formation. These jobs are designed to give very high stalled output pressure. The minute circulation is broken, the pressure drops and the pump speeds up. The action of the converter is such that the maximum volume will always be displaced for the particular pressure requirements. There is no need to stop and change gears in order to obtain higher volumes as the pressure decreases.

Converters are also useful on cementing-type operations or operations involved in killing a well. Under these conditions it is desirable to have large volumes at low pressures in order to pump the desired amount of fluid into the well and then to change without delay to controlled high pressure at little or no volumetric displacement.

This is automatically accomplished by the torque converter which operates at high output speeds under low pressures and low output speeds, or stalled output, under high pressures. The maximum high pressure is easily controlled by the throttle setting on the engine.

There are many other special jobs that can be easily and effectively handled through a torque converter that are difficult to perform with a conventional internal-combustion engine powered rig or pump.

Applications of Hydraulic Couplings

More than 250 Gyrol drives, or scoop-type couplings, has been installed on some of the largest drilling rigs. An outstanding installation of hydraulic couplings is on Superior Oil Co.'s National Consolidated 160 rig powered by three eight-cylinder, supercharged 670-hp. engines and the independent pump driven by two more of these same engines. Each of the six engines is equipped with a Gyrol drive. This rig recently broke the world's depth record and succeeded in drilling to a depth of 20,521 ft.

Hydraulic torque converters in capacities up to 300 hp. at approximately 1,800 r.p.m. have been commercially available for a number of years. This horsepower speed range was ideally suited for the single-engine, highly mobile drilling units. It is therefore natural that the initial installations of torque converters were made on light drilling equipment. Several manufacturers now consider torque-converter drives as standard equipment and conventional drives as an optional alternate or as something that they cannot furnish.

The Author

Nicholas A. D'Arcy, Jr., has his own engineering equipment sales organization in California, starting in business in 1947. Prior, he was a partner in Charles W. Carter Co. for 3 years, and was employed for 10 years by Emsco Derrick & Equipment Co. He is a member of the A.S.M.E., A.I.M.E., and a registered mechanical engineer. He has presented several papers on oil-field equipment and his specialties, hydraulic drives and friction clutches. The accompanying material is a portion of his paper presented at the annual A.A.O.D.C. meeting at Dallas, September 19-22.

Recent years have seen the development of torque converters for application to 300-hp. 900 r.p.m. engines and several applications have now been made to heavy drilling equipment. At the present time, one of the leading manufacturers of oil-well equipment is building a torque converter for application on the largest supercharged diesel engines. It will be capable of transmitting between 600 and 700 hp. at 900 r.p.m.

The development of these large converters opens up an entire field to torque converters. Field tests run on both the single-engine mobile drilling equipment and on heavy drilling equipment proved conclusively that the hydraulic torque-converter-equipped rigs will hoist drill pipe faster than identical rigs equipped with mechanical drives, these tests being made by impartial observers.

To obtain the ultimate economy from a torque-converter installation the rig should be designed specifically for use with converters. There are numerous savings, particularly in the number of speeds required in a rig designed specifically for torque-converter operation, and these savings often help pay for the cost of the converters. In addition, a rig designed for use with converters should have the proper speed ratio for hoisting, rotary-table drive, and slush-pump drive. On conversion jobs great care must be exercised in order to obtain the proper ratio to all drives and in that way maintain high converter efficiency.

Effectiveness on Slush Pumps

Many people have questioned the advisability of installing torque converters on slush pumps, but 5 years of experience with slush pumps operated by drilling contractors and company operated crews proved the effectiveness of converter slush pump

drives. The combination single-stage torque converter and coupling with its high efficiency and comparatively low torque multiplication are particularly desirable on slush-pump drives.

Care must be taken to select the proper ratio between the converter and the pump in order to produce the desired pump characteristics and to obtain good converter efficiency. When proper ratios are selected it is practical to obtain a 2:1 reduction in pump speed with approximately a 2:1 increase in pump pressure. This would mean that a pump ratio having a top speed of 60 s.p.m. and 450 psi. could be efficiently slowed down until it reached a speed of approximately 30 s.p.m. with a resulting pressure of 900 psi. During this full range of speed the operator would be obtaining almost uniform hydraulic horsepower output from his pump which would mean that the maximum volume of mud would be circulated under all conditions. Slush pumps in operation range in size from 7¼ by 14 to 7¼ by 18 in. To the writer's knowledge no one has even damaged a pump because torque converters were used in the drive. The pump operators claim large savings in liners, pistons, and chain.

Not a Luxury Item

Hydraulic torque-converter drives on a mud-mixing pump looks like a luxury item but they need not be. This is one place that an operator can well afford to use a small pump with high-pressure capacity for his mud-mixing pump. With this drive the pump should be ratioed to obtain maximum stalled pressure rather than maximum efficiency in operation, as efficiency in a mud-mixing pump is a minor consideration. The high stalled pressure will provide the operator with a high-pressure pump suitable for breaking, circulation, operating high-pressure rams, and in remote locations serving as a cementing pump. This equipment gives a drilling crew a standby high-pressure pump that will often be used in preference to calling out special rental equipment.

A number of hydraulic torque converters are being used to drive special-purpose high-pressure pumps. One example is the modern power-driven cementing pumps used by International Cementers, Inc. These cementing units include Hall Scott 400 engines for driving both the truck and the pump. The truck drive is through conventional transmission and the cementing pump is a six-cylinder Gardner-Denver plunger-type pump and the drive through the pump is through the hydraulic torque converter. The converter itself provides a range of speeds on the pump from approximately 120 s.p.m. to stalling and the pressure range is from approximately 200 to a 15,000-psi. test. Part of the range in pressure is obtained through the construction of the pump and part through the action of the torque converter.

A number of high-pressure torque converter equipped slush pumps are used in production work for killing wells, washing out perforations, and reversing circulation into the formation.

Future Potentials of Hydraulic Drives

The writer expects to see an increasing number of Gyrol drives on large drilling rigs and large slush-pump installations. They have proved their worth on this type of equipment. There is some question as to the advisability of using Gyrol drives on smaller installations and it is entirely likely that this field will remain largely a torque-converter field for those who desire the flexibility and economy obtained with hydraulic drives.

The manufacturer of the new 600-hp. 900-r.p.m. torque converter is designing a complete and revolutionary line of equipment, all incorporating and requiring a hydraulic torque converter in the drive. This equipment will offer automatic weight control, automatic feedoff of the drilling line, automatic selection of the proper hoisting and rotating speeds, and will incorporate sufficient cooling capacity in the converter so that it can be used as a brake during normal round-trip operations.

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Making Hole in California

by Robert Harwick
District Editor

THE largest production-model drilling rig employing torque conversion for power transmission is making its first hole near Anaheim, Calif. It is on a wildcat location, Section 8-4s-10w, Orange County.

The well is 48-8 Anaheim Community of Amerada Petroleum Corp. On September 1, after side-wall sampling, the rig was drilling ahead at 8,478 ft. with 1,001 ft. of 11¾-in. casing in place. Contractor is Santa Fe Drilling Co. of Santa Fe Springs, Los Angeles County.

The rig in use on this test is the biggest of the Ideco 700 series; the Hydrair 7-11. The rig was built in Beaumont, Tex. It marks an introductory move bringing torque-converted power out of the small draw-works class and applying it to standard draw-works assemblies for deep-well drilling.

There are two basic models of the Hydrair 7-11. One, the 7 group, is capable of accepting 700 hp. into the draw works. The other, the 11 group, is rated at 1,050-hp. input. These two basic groups have almost complete interchangeability of parts. The chief difference is a variation in clutch size.

The rig is use at Anaheim is of the 11 group, rated at 1,050 hp. The rated drilling-depth capacity is 11,000 ft., 4½-in. diameter pipe. Power is supplied by three General Motors twin six-cylinder diesel engines, through Twin Disc torque converters.

The features of the draw works are torque-converted power, full air controls with air clutch throwout, and packaging of the various subassembly units for highway transportation.

The principle of torque conversion as applied here is the same as in most fluid-drive installations: a centrifugal pump and hydraulic turbine within a common housing. The converter provides infinitely variable speeds with high torque multiplication. As load is applied the torque converter automatically adjusts speed ratios to meet load requirements.

As an example the rig gives maximum speed for raising the empty block and maximum pull for coming out of the hole, without engine throttling or shifting of gears.

There is a two-speed forward and one-speed reverse transmission to both the drum drive and rotary drive. This provides the means for efficient application of power under all conditions. The speed ratios in this transmission give an adequate overlap between high-speed and low-speed operation.

All controls are mounted at the driller's position and are so designed that the control box can be removed in one piece without breaking any of the air piping. Controls are hand-throttle activated. Air interlocks with the control valves permit complete flexibility of operation and throttle-control selection.

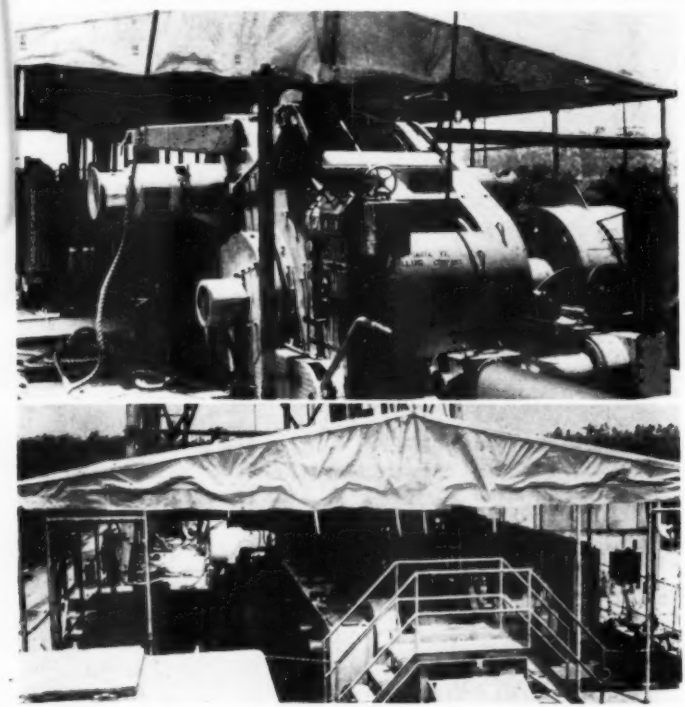
The draw works is the double-drum type, 24 by 42 in. It operates through chain drive. The drum clutch is a Fawick Airflex. Brake is 46 by 10.5 in. There is a model 5032 Dynamatic brake clutched onto the main drum shaft for auxiliary braking. The Dynamatic brake is 50 by 42 in. It has its own cradle mounting. The brake is energized by means of a rectifier used in conjunction with an a.c. light plant.

The draw works is also equipped with automatic spinning and breakout catheads, mounted on the sandline drum shaft. The sandline drum is the free-spooling type.

The rotary table is driven by a propeller shaft drive through a 90° gear box, or through chain drive. It is possible to use a combination of these two drives.

The draw works and transmission are one unit, in the 11 group, and

Top: Driller's position on the new draw works. All controls are mounted in the box which can be removed in one piece. Bottom: View from the rear of the engine. The three twin diesels are chain compounded. All compounding is controlled from the driller's position



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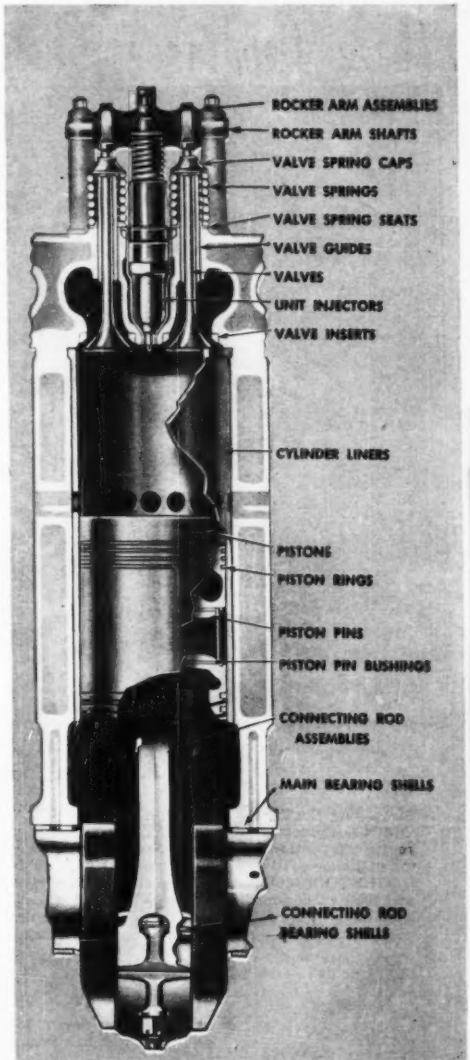

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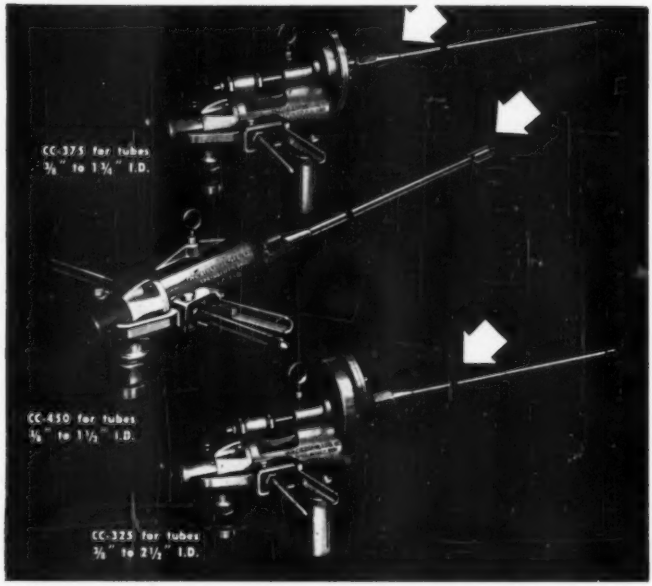

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can be shipped as one package. With the cathead and auxiliary brake removed this package complies with highway transportation laws.

The rig in use by Santa Fe Drilling Co. at 48-8 Anaheim Community has its own compound and engine frame. This frame is doweled and locked into the mating face on the draw works during operations. The compound and compound frame of this group ordinarily are moved as separate units. However, Santa Fe Drilling Co. has mounted the complete draw works, compound, engines, and dynamatic brake assembly on a subbase. This arrangement makes it possible to make field moves with the complete assembly.

The engines supply power to the compound through Twin Disc torque converters. The output of the converters is applied to the compound through the Airflex clutches. These are located on the outside of the compound case.

The compound is the chain-sprocket type. It has one pump drive and no auxiliary drives on this particular installation. All compounding, pump drive, and engine power-takeoff clutches are controlled from the driller's position. Any practical combination of power can be obtained from this main control position.

Each engine is so mounted that it can act as an individual unit. There is a separate subskid for each engine. These are mounted on the frame, doweled into the compound case, and locked in place. An engine can be moved easily by releasing the air pressure in the clutch and unlocking the skid from the frame.

Lubrication of the moving parts on this rig is provided by oil bath or drip in the case of chain drives. Bearings and other moving parts are pressure lubricated from a central point. All chains and sprockets run in oil-tight guards. All bearings are sealed. Oil-tight inspection doors are placed at strategic points.

An outstanding point about the operation of this rig near Anaheim is the quietness of the operation. The fluid drive and air clutches combined with engine muffling make for practically silent drilling.

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Rated drilling capacity.—Approximately 11,000 ft., 4½ in. drill pipe.
Power.—Maximum rated input, 1,050 hp. Engines, 3 G.M. Twins with Twin Disc torque converter.
Compound.—Drives: One, two, or three engines to draw works. Clutches: Fawick Airflex.
Transmission.—Speeds: Two forward, one reverse. Drive: Chain. Clutches: Fawick Airflex.
Hoisting.—Drive: Chain. Drum clutches: Fawick Airflex. Drum: 24 by 42 in. Brakes: 46 by 10.5 in.
Rotary drive.—Either chain or right angle shaft.
Controls.—Full air control at driller's position.
Dynamatic brake.—50-32

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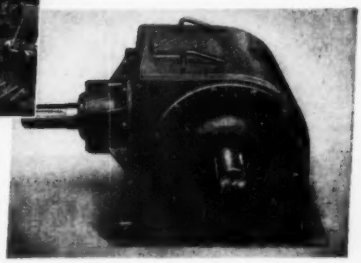

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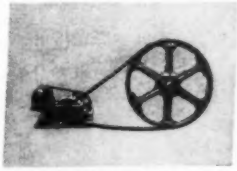
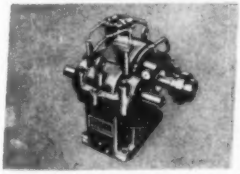


Bandwheel drives for economical pumping



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● The Kellys are then carefully bored by precision drilling machines so that the bore is precisely centered end-to-end, then double-checked by highly-accurate survey devices. For products with bores 2¼" diameter or larger, wall thickness of the Kelly *must not* vary more than one-*sixteenth* inch for each 10 ft. of product length, or fraction thereof.

● The Kelly itself is also accurately surveyed for straightness and *must* be straight within one-*eighth* inch when measured at any point over its entire length.

● The alignment of the projected axis of each threaded end, when checked with the precise Baash-Ross Alignoscope, *must* be within one-*eighth* inch of the longitudinal axis of the Kelly for each 10 ft. of Kelly length, or fraction thereof.

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2½	35	30-4	4½ Hex	5½	2⅜ Hex	5½	1¼	3⅛	2½	5⅛	9/16	3⅜	*16.5
	40	35-4	4½ Reg.		2⅜ I.F.		1⅛						32.7
3	35	30-4	4½ Hex	5½	2⅜ Hex	5½	1¼	3⅝	3	5⅛	⅝	4⅛	*16.5
	40	35-4	4½ Reg.		2⅜ I.F.		1⅛						32.7
3½	35	30-4	4½ Hex	5½	2⅜ Hex	5½	1¼	4⅛	3½	5⅛	⅝	4⅛	*16.5
	40	35-4	4½ Reg.		2⅜ I.F.		1⅛						32.7
4	35	30-4	4½ Hex	5½	3½ Reg.	6⅜	2¼	4⅝	4	6⅛	¾	4⅝	*16.5
	40	35-4	4½ Reg.		3½ F.H.		1⅞						32.7
4½	35	30-4	4½ Hex	5½	3½ Reg.	6⅜	2¼	5⅛	4½	6⅛	¾	5⅛	*16.5
	40	35-4	4½ Reg.		3½ F.H.		1⅞						32.7
5	35	30-4	4½ Reg.	5½	4½ Reg.	6⅜	2¼	5⅝	5	6⅛	¾	5⅝	*16.5
	40	35-4	4½ Reg.		4½ F.H.		1⅞						32.7
5½	35	30-4	5½ Reg.	6⅜	4½ Reg.	6⅜	2¼	6⅛	5½	6⅛	¾	6⅛	*16.5
	40	35-4	5½ Reg.		4½ F.H.		1⅞						32.7
6	35	30-4	5½ Reg.	6⅜	5½ Reg.	6⅜	2¼	6⅝	6	6⅛	¾	6⅝	*16.5
	40	35-4	5½ Reg.		5½ F.H.		1⅞						32.7

* Alternate 5¼ inches O.D. ‡ 100 cu. ft. per lineal ft
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Drilling Handbook

Special Section on Modern Equipment and Practices

RIGGING UP

Mobility in Drilling Units*

INSOFAR as mobility of drilling units is concerned, it is believed that the subject should be divided into two distinct phases: (1) The design and layout of drilling equipment, and (2) the scheduling of the drilling program which determines hoisting and circulating requirements and thus equipment sizes and weights. (For example, reducing hole size will have an attendant reduction in circulation rates and drill pipe weights and hence concomitant reductions in hoisting and circulating requirements which within certain limits allows achievement of mobility over that normally obtained with conventional drilling programs).

The first phase, design and layout of equipment, embodies fundamental considerations of bulk, weight, and means of assembly that are employed to obtain mobility. The usual technique, particularly employed by contract drillers, is to emphasize unitization of individual pieces of equipment which may be dismantled into legally transportable packages and easily reassembled. Another technique which is very effective when used in conjunction with an extended drilling program in one area, and particularly where the terrain is relatively flat, is to assemble large units weighing many tons which may be skidded or moved by special equipment without much regard for bulk. When this technique is used, no attempt is made to dismantle units

*W. F. Bates and J. N. Gregory, Shell Oil Co., Inc. Summarization of paper presented at meeting, Pacific Coast Division of Production, A.P.I.

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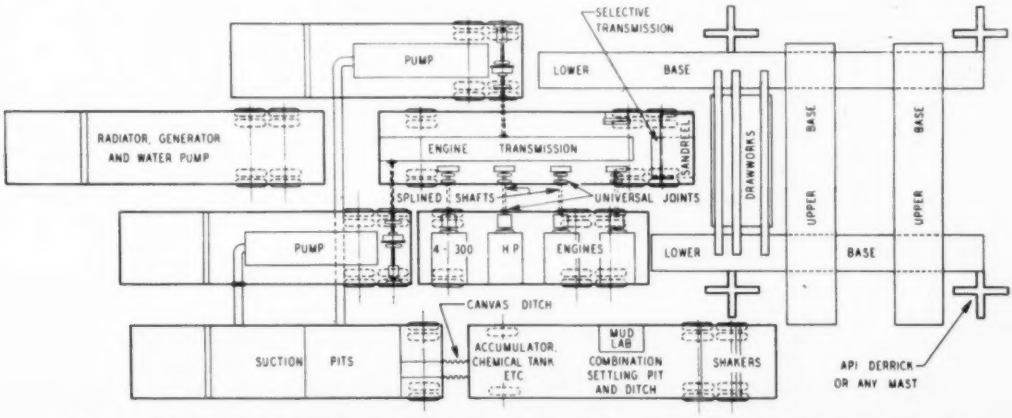


Plan of a highly mobile, completely unitized light rig. All machinery is placed on a lower level than the derrick floor

into legal-size packages except on long moves.

A third and perhaps newer technique depends on a reconsideration of the functions of drilling machinery with the purpose of designing and assembling equipment which approaches the optimum in mobility as well as utility. One of the first steps along this line was made when sectional portable masts were offered which could be moved intact between wells in one area or broken down into smaller pieces for over-the-highway moves. Other improvements, such as skid-mounting equipment which may be dowel-positioned on other bases located on the ground, have been made and will continue to receive full consideration. Nevertheless, there are still many improvements that can be made in drilling equipment if the ultimate in mobility is to be achieved. However, it is important that all designs to obtain greater mobility recognize that the drilling equipment must perform its primary function of making hole economically, and two other criteria should be kept in mind; rig floors must be high enough to allow for mud circulation and adequate blowout equipment without the hazard and expense of deep cellars, and the equipment should be so arranged that the normal drilling crew can dismantle and assemble it with but little extra help. With these thoughts before us, some of the more important fundamentals which must be considered if mobility is to be achieved are:

1. All component parts of a drilling rig, including the derrick, should be portable.
2. Individual loads should be legally portable, both in weight and bulk.
3. Whenever economical, units of equipment should be mounted on wheels.
4. Assembly work at the rig site must be kept to a minimum by grouping pieces of equipment into the largest legally portable units possible.
5. Provision must be made for handling heavy loads readily.
6. The requirement for accurate alignment between individual units must be kept at a minimum.

If drilling equipment is to conform to these fundamentals, certain changes must be made in conventional equipment. Draw works and similar operating equipment must be controlled remotely if the primary machinery is to be at one level and the working platform at another.

Individual loads may be lightened in various ways, through intelligent design and use of materials and by paying particular attention to the function of certain parts of the equipment. For example, conventional derrick substructures are built to support the weight of the rotary table and drill pipe. If it is granted that the rotary table may be supported on the well column itself, i.e., the drilling riser, and that the drill pipe may be racked on the ground or independent of the floor, one of the functions of the conventional substructure which requires its heavy construction is eliminated. This leads to the possibility of placing the floor at a height independent of the machinery and permits the floor to be designed specifically as a working platform. Furthermore, if the working platform is made independent of the machinery and derrick, a universal substructure and floor which may be used with any derrick and machinery is feasible.

Assembly work at the rig can be reduced by grouping such pieces of equipment as water circulating pumps, air compressors and electric controls on one unit which may be connected to the drilling rig with flexible connections such as hoses, cables and swing joints.

Each piece of equipment requires its own study as to its best location and arrangement. The economics of special loading apparatus that may be necessary, or the possibility of equipping machinery with wheels must be investigated. Since drilling equipment is usually of such nature that it does not fit conventional rolling stock, it may be necessary to design a trailer as part of the piece of equipment.

As a result of the analysis of mobility requirements and with a recognition of the changes necessary to adapt conventional equipment to such requirements without sacrificing rig performance, a drilling unit was designed and built and put in operation.

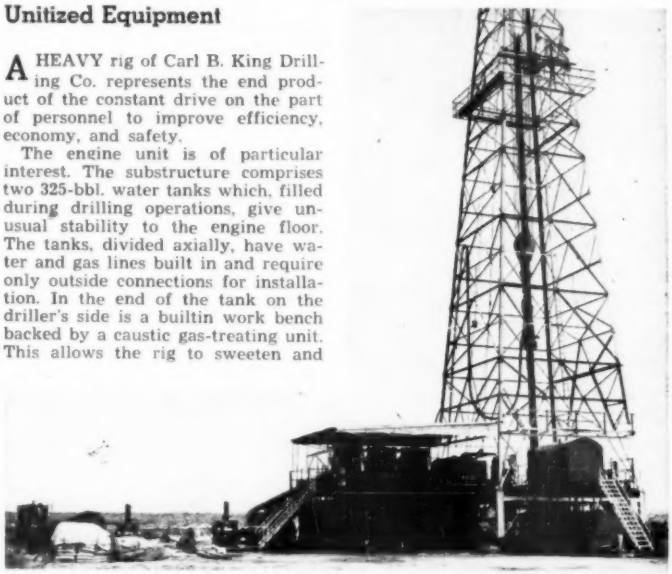
The design of smaller drilling units is closely related to the second phase of mobility achievement. In regard to this second phase of mobility which concerns hole and drill-pipe size, there is a great deal of room for experiments and improvements in technique and equipment. Basically, if you cannot build equipment light enough to be portable and still be able to handle the necessary loads, consideration should be given to making the loads lighter so that portable equipment can handle the loads. Theoretically, this is readily accomplished by drilling slim holes with lightweight drill pipe.

Although the term "slim hole" can cover quite a range of hole sizes, for the purpose of this discussion a slim hole shall be considered a 6¾-in.-diameter hole. Carrying this size hole to depths of 8,000 ft. is not a new idea as it has been done on many occasions. Through the use of slim holes, it is possible to use smaller pumps and drill pipe. A reduction of the latter automatically reduces hoisting equipment requirements and, therefore, offers the greatest challenge insofar as over-all reduction of size of equipment is concerned. Conversely, a reduction in drill-pipe weights permits drilling deeper with available lightweight portable equipment.

Unitized Equipment

A HEAVY rig of Carl B. King Drilling Co. represents the end product of the constant drive on the part of personnel to improve efficiency, economy, and safety.

The engine unit is of particular interest. The substructure comprises two 325-bbl. water tanks which, filled during drilling operations, give unusual stability to the engine floor. The tanks, divided axially, have water and gas lines built in and require only outside connections for installation. In the end of the tank on the driller's side is a builtin work bench backed by a caustic gas-treating unit. This allows the rig to sweeten and



Reinforced water tanks form the supports for the drilling engines on this heavy rig. Engines, tanks, and draw works may be moved as a unit by the skidding method

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Up to twice the production is possible when a conventional unit of short stroke and relatively fast speed is replaced with the long stroke of the Axelson Hydraulic Long Stroke Pumping Unit.

Increased Stroke Length — up to 26½ feet total — reduces stroke loss due to rod and tubing stretch, increases plunger travel, decreases frictional wear, and assists in handling gassy fluids.

Fewer Stroke Cycles per Minute — from 3 to 6 spm — reduces rod string reversals, decreases impulse load factors and problems created by second and third order synchronous speeds, permits operator to increase pump size or depth or lighten the rod string.

Longer Sucker Rod Life — because operational characteristics of the Axelson Long Stroke Unit reduce peak stresses, stress range and cycle rate, and provide cushioned power applications, thus effecting savings by eliminating down-time.

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in Deep Well Plunger Pumps, Sucker Rods and Pump Components Since 1892

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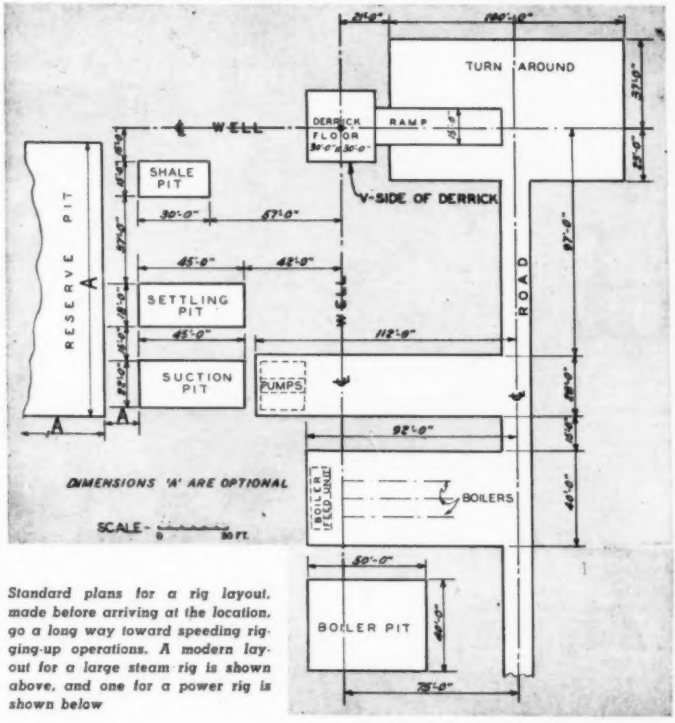
use a sour field gas which generally is available in West Texas.

Unitized engine and draw-works foundations rest directly on supports welded into the steel tanks. Floor sections, hinged to engines and draw works, have been elevated to a height flush with the derrick floor. The overhanging walkways which let down on each side of the engine-compound unit are hinged to the substructure and are supported by heavy diagonal braces which slip over studs welded into the tank walls. In transit these walkways are folded down to the tank sides and each substructure unit forms a load measuring 32 by 10 by 8 ft. Rail posts and roof supports are set into fabricated sockets around the floor's edge. Guard-rail posts are drilled for rapid stringing of 1-in. rails.

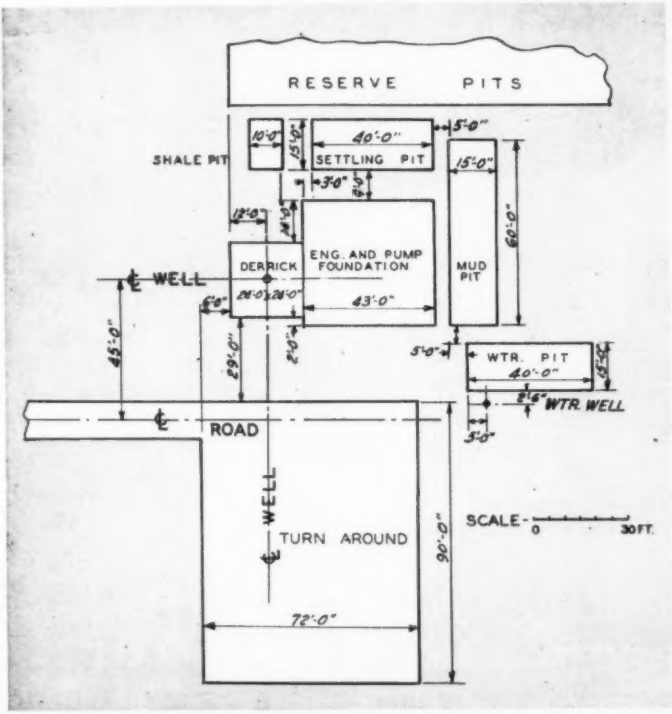
The roof framework is composed of 1¼-in. pipe trusses with 1-in. cross members, topped with 2½-in. tubing. The painted 16-gage sheet-iron roof panels, roughly 5 by 9 ft., are welded to angle-iron frames. These panels overlap down pitch, and where they join over the trusses their edges are inserted into slots cut in the tubing, giving complete overhead weather protection. Piping installed in the roof members provides water through flexible hoses to engine radiators and exhausts. Sprays are turned into the exhausts when fire precaution is in order. When rigging up, only one hose connection is required between the substructure tanks and the draw works. Water from water-cooled brakes and the hydromatic brake is returned to the tanks through a builtin rundown line.

Unitized pipe racks of six 24-ft. sections flank the walkway—four sections and a 10-ft. gate section on the driller's side, and the remaining two racks, opposite. The telescoped legs are drilled for pinning to three different heights. The 4-in. horizontal members, trussed with 3-in. pipe, are joined by a simple hook and slot at the top and slot and stud at the base. The 5 by 60-ft. walkway with a bolted floor of 3 by 12-in. planks breaks down into two sections, and when inverted acts as a carrier for the pipe racks.

Two dog houses at the rig are mounted as one unit. The lower, which forms the substructure for the upper house and walkways, is used for storage of parts and supplies.



Standard plans for a rig layout, made before arriving at the location, go a long way toward speeding rigging-up operations. A modern layout for a large steam rig is shown above, and one for a power rig is shown below



Standardized Rig Layouts*

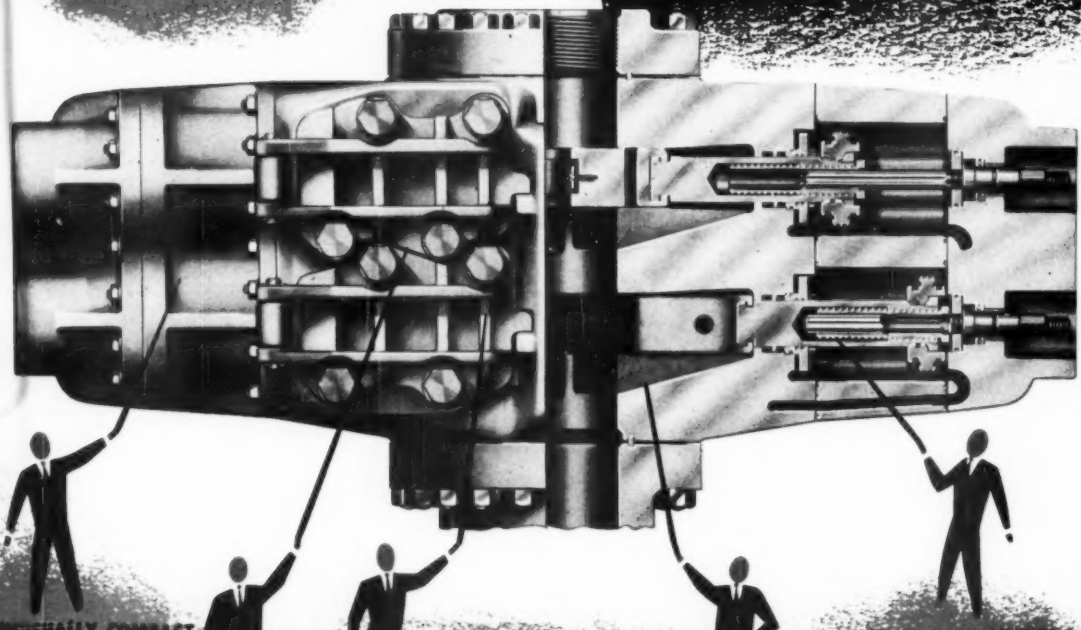
A LOCATION layout of a large modern steam rig is shown in an accompanying illustration.[1] The layout shows the "in line" arrangement of engine, pumps, and boilers. It has

*Joseph Zaba, chief mechanical engineer, Stanolind Oil & Gas Co.

Announcing the greatest

Here's what oil operators everywhere have been waiting for—a *Hydraulic* Cellar Control Gate that is **COMPACT** and **COMPLETELY ENCLOSED** . . . as well as simple to service, easy to install and extremely dependable. You get all these features—*and many more, too*—in the revolutionary new Shaffer Hydraulic Cellar Control Gate, the greatest control gate advancement in a decade.

The SHAFFER Hydraulic CELLAR CONTROL GATE!



UNUSUALLY COMPACT
A Double Gate measuring less than 30" in overall height, even in sizes as large as 13⅝" . . . smaller sizes proportionately less!

TWO GATES IN ONE
Two separate ram compartments unitized into one compact body—actually two Hydraulic Gates in one!

FAST RAM CHANGES
Simply unbolt door on side of Gate, slide old ram out, change ram, slide ram back in, bolt door shut. It's as simple and fast as that . . . and complete ram changes can be made whether pipe is in or out of the hole!

QUICK-DRAINING BODY
Rams travel on narrow guide ribs high above a steeply-sloped self-draining ram compartment bottom. No detrimental sand or mud accumulation!

DIRECT HYDRAULIC DRIVE
Fluid Power—Direct Action—Positive Operation! All moving parts protected within the body.

control gate advancement in a decade!

AFTER A LONG PERIOD of engineering development and testing, Shaffer proudly announces its new Shaffer Hydraulic Cellar Control Gate—*two* separate ram compartments unitized into *one* body *with an overall height of less than 30" even in sizes as large as 13⅜"*—as well as space savings in both length and width!

That's *real* compactness—that saves valuable cellar space on every rig where it's installed—that permits more compact hook-ups, more space in the cellar for other equipment, plus vital space savings in storage and shipping.

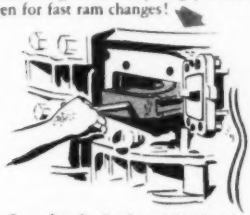
Note in the accompanying table the amazingly small overall height of the new Shaffer Hydraulic Gate in the various sizes. Then remember—this small height includes *two* separate ram compartments in the *one* body—in reality two hydraulic gates in one.

SHAFFER HYDRAULIC GATE DIMENSIONS

Gate Size	7"		9"		10¾"		13⅜"	
Working Pressure (PSI)	3,000	5,000	3,000	5,000	3,000	5,000	3,000	5,000
Bore	7 1/16"		9"		11"		13 5/8"	
A—Height . . . inches	25	26 1/2	25 1/4	27 1/2	27 1/2	30 1/2	30	36 1/4
B—Width . . . . inches	28 5/8	31 1/2	31 5/8	35 1/4	34 1/4	37 5/8	40	40 1/2
C—Length . . . inches	70 3/4	70 3/4	71	72	79	81 1/4	88 1/2	88 1/2

New Simplicity In Changing Rams

Best of all, unusual compactness is only *one* of *many* new features in the Shaffer Hydraulic Cellar Control Gate. It's the simplest Gate you ever saw when it comes to changing rams. Each ram assembly is readily accessible through a quick-opening side door hinged to the Gate body. By simply unbolting the door and swinging it open, the ram assembly can be pulled right out. Change the ram assembly, slide it back in—then close and bolt the door. It's so simple, so quick, so time-saving it beats anything you've ever seen for fast ram changes!



Completely Enclosed Hydraulic Operation

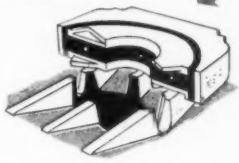
Here's something else—all moving parts in the hydraulic cylinder, including piston rod ram shafts, are completely enclosed. There are no moving parts projecting from the Gate—nothing to become damaged or wedged by loose pipes or timbers in the cellar—nothing to become corroded by salt fluids or chemical muds dripping down into the cellar. Even the locking shaft is completely enclosed and stays enclosed in all positions because it is non-rising.

Corrosion-Free Hydraulic Cylinders

All operating parts in the hydraulic cylinders are of either stainless steel or manganese bronze. Therefore, although hydraulic oil is recommended as the operating fluid, water can be used without risk of corrosion, rust or damage to parts.

Self-Draining Ram Compartments

Another important point—note how the rams travel on high narrow guide ribs raised above the steeply sloped bottoms of the ram compartments. No detrimental sand and mud accumulations can interfere with the operation of the rams because mud and sand drains right back into the well from the Gate body. Any that does remain is far below the ram operating level and does not interfere with free ram travel—therefore cannot keep the rams from closing and sealing.



Interchangeable Ram Blocks and Rubbers

Shaffer Hydraulic Cellar Control Gates have still another advantage—they use the same ram rubbers and ram blocks, size for size, that have proven so dependable in mechanically-operated Shaffer Cellar Control Gates. Where both types of Shaffer Gates are used in a field, ram rubbers and ram blocks can be used interchangeably, reducing inventories and simplifying maintenance!

GET THE FULL STORY of this great new Shaffer advancement. There are many other features you should know about. Write for complete details!

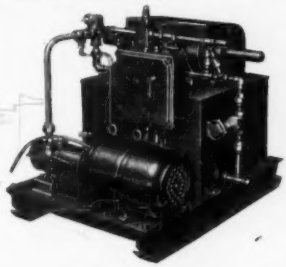
Send for your copy of the complete Shaffer catalog

Compact Power Closing Units

Because of its lower overall cost, its savings in maintenance and its low freezing point, it is recommended that hydraulic oil in a closed system be used to operate Shaffer Hydraulic Gates. Two types of power closing units are available for supplying the necessary pressure—one operated by electricity, the other by air, gas, steam or water pressure—thus providing a type of power to meet every rig requirement.

Both types have high volume pumps which assure closing the Gates within seconds.

In addition Shaffer Hydraulic Gates can also be closed *mechanically*, assuring full protection in case of power failures.



Centralized Control Panel

Complete control of the power closing unit, as well as of the opening and closing of the rams in both compartments of the Gate, is centralized in a compact unitized control panel that can be placed alongside of the driller or at any other convenient location.

Three manually-operated 4-way hydraulic valves are built into the panel—two of the hydraulic valves control the opening and closing of the rams—one for each compartment of the Double Gate—and the third valve can be used to control other hydraulic equipment or to operate another Gate.

These valves can also be operated by remote control, permitting auxiliary control stations to be installed at a distance from the rig if desired—an important safety feature.

The entire control panel is unitized and can be moved from rig to rig with minimum installation and break-out time.

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KA-MO EARTH BORING EQUIPMENT

— Bores horizontal holes *fast*, goes under highways, streets, railroads, canals, channels, streams, ditches, foundations, etc.

— For oil, gas or other pipe-line mains and service connections.

Leaves Ground Surface Undisturbed!

Eliminates expensive trenching, back-filling, refilling, tamping and expense of repairing or maintaining highway, street or other surfaces above pipe-lines. Boring is often done *through a caisson, which is moved along as work progresses, and prevents the ground from caving in.*

KA-MO Boring Equipment works in a trench when boring horizontal holes. It is operated by an air or electric motor, with power unit located several hundred feet away if desired. Using a light tripod for support, KA-MO Equipment drills holes on slopes or in locations inaccessible to trucks or tractors. *The same equipment bores vertical holes for poles, posts, piling, anchors, etc.*

INEXPENSIVE!

KA-MO Drills are manufactured in diameters from 3 to 24", and in 4' sections, which hook into a continuous boring tool as the work progresses.

Complete information and prices will be furnished upon request.

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CAST IRON PIPE
FOR LONG LIFE AND ECONOMY

several features which represent a radical departure from the long-accepted norms of setting up a rig.

The V-side of the derrick is facing the boilers. This fact together with proper arrangement of pits and pumps in relation to the roadway results in a very considerable saving in the space needed for the location as a whole. This is an important advantage in case of all difficult locations and in case of locations in cultivated areas where space is at a premium.

The boilers are set with their firebox ends lined up on the center line of the well. In moving, the pumps are skidded first in their place on the pump platform, which accommodates also the mixer and the storage house for mud materials. With the latter being placed closest to the roadway, handling of these materials in unloading from the trucks is reduced to a minimum.

A standardized location layout for a power rig is also shown here. The size of the rig has, of course, an effect on the dimensions and distances involved. The layout shows a compact arrangement of the location, particularly of the pit system, resulting in considerable saving of space.

Connecting Up

Some 15 or 20 years ago connecting up of a rig was, in a majority of cases, a project in itself. Measuring, cutting, and threading of large quantities of pipe, making up of innumerable connections, and considerable welding were operations required at each new location. Arranging of heavy equipment required considerable improvisation. Under present conditions and with the size of a modern rotary rig such a method of approach would not be feasible and the picture has changed completely. With unitized equipment and standardized layouts the setting up of a rig is a routine operation. With crews well trained and familiar with the arrangement the operation proceeds rapidly and efficiently.

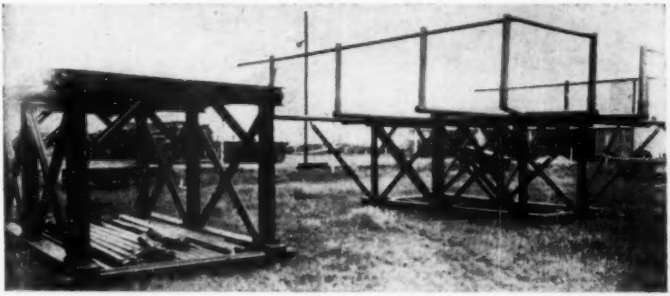
References

1 Rowan Drilling Co., Fort Worth

Engine Platforms

DISCARDED drill pipe and tool joints were the principal materials used in making these drilling-engine platforms. The one at left shows the platform dismantled and all piping placed inside the substructure for moving to the field, while the one at right shows the pipe in an installed position ready to receive the flooring.

As shown in the photographs, tool joints are welded to the upper beams of the substructure and to the horizontal lengths of drill pipe which support the flooring. Each connection on the substructure is numbered and the pieces of drill pipe which go to make up an extension and guardrail support are each given a corresponding number. This greatly facilitates the reassembly of the platform after the unit is moved to a new location.



This is a unique drilling-engine platform which may be quickly assembled and dismantled through the use of discarded tool joints

Lengths of angle iron assist in carrying any loads placed on the outer edges of the platform. Only two pins, one at either end, need be removed from each of these braces when the rig is to be moved. Holes cut in the upper ends of the uprights permit 2-in. line pipe to be inserted to form a railing around the platform.

Bases of the skids are completely covered with sheet steel to increase the bearing surface of the substructures. Addition of the steel bottoms also permits all dismantled members to be loaded in the unit when a move is made. The units shown here were fabricated by Ray Guffey Drilling Co. When moved to the field, volume tanks and necessary connections were to be installed in the substructures.

Track-Wheel Skidding

WITH this method, four track-wheel units, each of which supports a swivel carriage unit, are the "heart" of the novel system. Two medium crawler-type tractors furnish the motive power. No guy wires are necessary for the movement despite the fact the masts look topheavy. Flotation of the track-laying units is good enough to negotiate sand in which an oil-field truck will get stuck. Each set of tracks has 16 sq. ft. of ground-contact area. Speeds as high as 4 m.p.h. are not uncommon.

All that is necessary to get ready for a move of a jackknife rig is to disconnect the mud pumps and the water and gas lines. All types of miscellaneous equipment and tools are piled on the rig floor for the movement. Total load for moving a jackknife is variously estimated between 350,000 and 490,000 lb.

The swivel carriage unit can be described as a cradle on which the rig corners rest, the cradle being mounted between a pair of track-wheel units. As the name implies, the swivel carriage unit allows the load to change direction if this is desired. If not, a pin holds the unit in place.

Oklahoma Moving Practices

The first step in moving operations is to disconnet the mud pumps and water and gas lines. The next step is to jack the rig up, using tractor

winch lines, so that two H-beams can be bolted to the bottom of the substructure. These 26 by 12-in. H-beams (salvaged walking beams) run completely through the substructure and extend out a few feet on each side. The extension of the H-beams has been made into a box shape by welding steel plate to the beam. This box construction is designed to keep the beam from rocking after it is placed in the swivel carriage unit. H-beams are not used in moving the large derricks in areas where the swivel carriage unit can be placed under the corner sills.

After the H-beams have been bolted in place, the carriage units are placed under the box-like extensions. Log chains and boomers are used to fasten the beams to the carriage. A 1½-in. pin through the extreme end of the H-beam is used to prevent the carriage units from being pulled out from under the substructure.

With the four carriage units in place, the two front units are allowed to swivel and the back units are locked in place, the load following the tractors with only the front two units turning. A right-angle turn in 160 ft. of travel is possible.

A tongue assembly and a telescoping spacer bar is used to connect the front two carriage units to the first towing tractor. The telescoping spacer adjusts to fit rigs of various size and hooks up the front carriage units. The tongue is hooked up to each of the two front carriage units, and it is also hooked into the tractor.

No standard has been set up as to the maximum slope that can be negotiated in moving a rig on tracks. This is impossible, of course, as each job is entirely different. However, movers have figured that on a 136-ft. derrick with a 30-ft. square substructure one corner can be 4 ft. lower than the other three without any danger of overturning.

Rolling Heavy Rigs on Wheels

A METHOD of moving rigs on wheels is being employed under varying conditions in several different areas. In the Permian basin, over 90 per cent of all wells are contracted, and a brisk competition in rig efficiency has resulted. Drilling time per well has been steadily reduced since the war and the progress in penetration rates has reached a point where further improvement with existing methods will be slight. Time saved between contracts offers the best possibility at present for spreading overhead rig costs over a greater number of drilling operations.

The moving of a heavy rig in Wheeler field of West Texas, provides an interesting example of what can be done with wheels. The rig was highly unitized for rapid movement. The engine unit, mounted on two heavy water tanks, was designed for easy dismantling and rigging, requiring several loads in a normal move. When the decision was made to skid the unit intact, on wheels, the tanks were joined by additional bolted braces and the engine floor was reinforced with I-beams welded by braces to supports bolted to the tank sides. The entire unit was first skidded away from the derrick, and later wheeled as a single load to the new location.

Engine-shed supports were disconnected and the shed was secured to the derrick by means of guy lines. Guys also added further support to overhanging draw works and transmission assembly which remained in place on the derrick floor. The rotary table, kelly, blocks, wire lines, hydromatic brake, and other derrick equipment were moved in one load with the derrick.

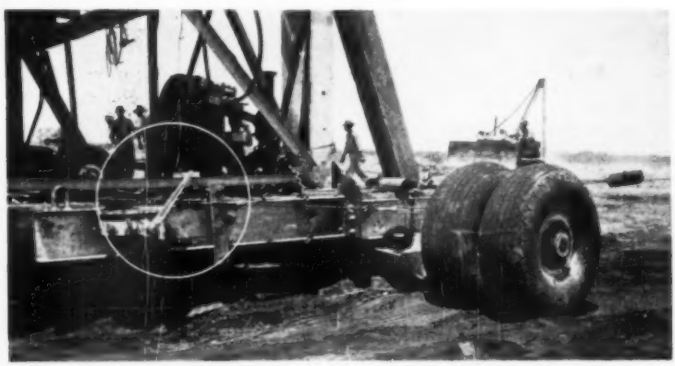
The rig-moving equipment features four four-wheeled dollies placed under derrick corners or engine-unit supports. At present, wheels made for the Army's C-47 transport plane are used. Measuring 45 in. in diameter, the 17.00 by 16, rib-type, 10-ply tires are rated for a capacity load of 30,000 lb. each. Each wheeled unit is equipped with a horizontal circular plate which supports the load. This seat revolves freely on the unit, allowing the wheels to be directed right or left to guide the rig in movement.

An ordinary derrick can be turned 90° in about 50 ft. of travel by cutting front and rear units in opposite directions to the limit allowed by the substructure clearance. An average travel rate approaching 3 m.p.h. has been reached with some loads. In the case of the rig pictured here, actual movement was much lower.

A heavy skid plate between the dual wheels of each unit has a ground clearance without load of about 6 in. Under load, the tires, inflated to 55 psi., flatten slightly, further reducing plate clearance. This feature provided sufficient safeguard against overturning a load in case of tire failure.

A rig is loaded by one of two methods. The wheeled units may be moved into place under support sills with tires deflated and the load lifted into carrying position by inflating the tires. Or, sills may be jacked to a height which will allow the units to be placed in position with tires inflated to normal pressure. As soon as a unit is properly placed, side plates are bolted to it, and secured to the sides of the sills by means of long bolts top and bottom. Each corner of the load is guided manually. A ratchet lever turns a worm gear, rotating a horizontal toothed wheel which directs the wheels by means of a chain drive and cables attached to the axles.

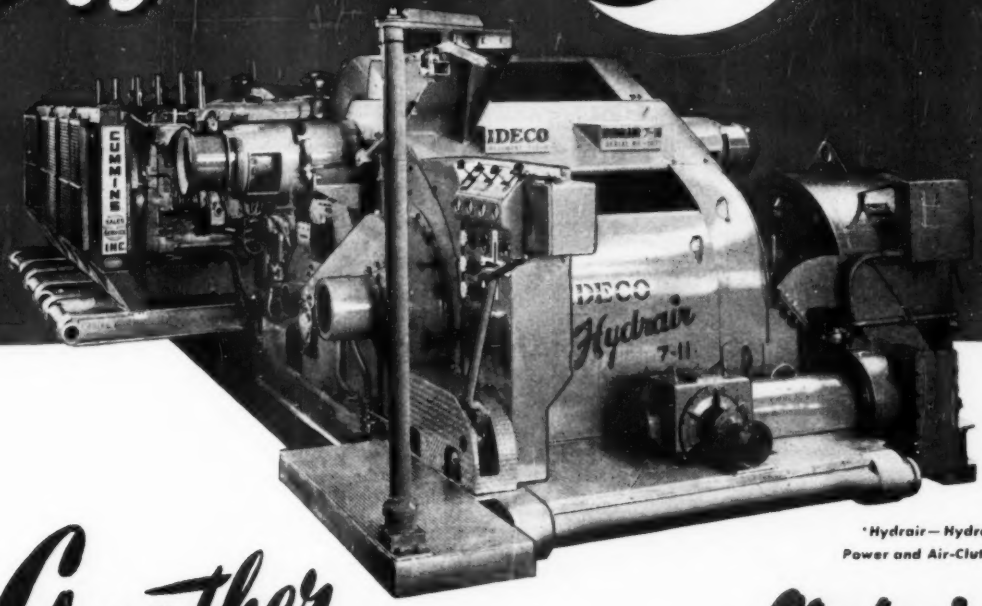
Motive power required for a move depends on the load and terrain. In this case the derrick was winched from location by a truck and D-6 tractor in tandem, and the two prime movers sufficed to move it most of the distance to the new location. Heavy squeeze sills were placed between the main support sill to prevent buckling of the derrick substructure by the converging pull of tow lines from the truck. The total derrick load, including all derrick-floor equipment excepting a dog house, was estimated at 220,000 lb. Considerably more than half this load was supported by the two dollies on the draw-works corners of the derrick. As a result, the four tires on each unit partially flattened and sank in soft sand until the skid plates rested on the ground.



Steering of the airplane-wheel units is done by manipulation of the lever and ratchet arrangement shown

700-1050 H. P.

Hydrair 7-11 RIG



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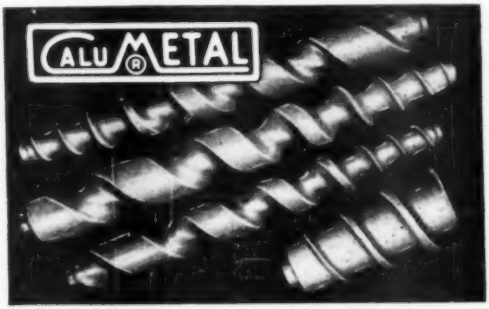

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Rating of Portable Masts*

A PORTABLE mast is designed to perform the same service previously rendered by the standard derrick with the added requirement that it must be more readily transported from one location to another. Its essential functions are the support of the crown block at a suitable height during the drilling and servicing operations and the support of the setback of pipe when it is out of the hole.

In the case of the standard derrick, years of background and relative simplicity of design have resulted in quite complete standardization. A.P.I. standards for these cover basic dimensions, capacity ratings, and design loads.

A.P.I. committee discussions and tentative specifications divide masts into the two broad general classifications, guyed and unguyed. In such discussions a guyed mast is one that depends for its stability on guys. Unguyed masts are those designed to stand and to support the pipe setback without dependence upon guys. In the case of masts coming under this classification guys are added only in case it is anticipated that the rig may overturn due to wind storms. Thus far, no A.P.I. standards have been outlined for unguyed or free-standing masts and standards relative to guyed masts are in the tentative stage.

The standard derrick is square in cross-section and the legs are supported by bracing in the plane of the face on all four sides. The legs of such a structure are definitely supported against buckling in any direction at every panel point, and loading on legs is approximately symmetrical; hence, after unit stresses are established and a column formula specified, all fabricators arrive at substantially the same capacity for equivalent derricks. The A.P.I. capacity of the standard derrick is the crown-block capacity and it is the sum of the capacities of the four legs acting as columns.

*H. D. Hilborn, chief structural engineer, Emsco Derrick & Equipment Co.

In addition to loads acting at the crown, the standard derrick must be capable of resisting large horizontal loads acting at the working platform and at the water table and relatively small horizontal loads acting at all panel points. All of these loads are computed in accordance with specifications adopted by the A.P.I. committees. Loads at the working board include the horizontal reaction from the setback of pipe standing on the derrick floor, the horizontal reaction from the wind on the pipe setback, and wind load against the derrick framing. At other panel points the loads are the result of wind blowing at a specified velocity against the structure.

As stated above, there are, at present, no A.P.I. standards covering unguyed masts but it will be agreed that the mast, to satisfy the operator's requirements, must satisfactorily support the same operating loads as a standard derrick. Long years of experience guide the user in his selection of crown-block capacity for a given depth of drilling with a standard derrick for the reason that such capacity, if A.P.I., is definite. In the case of a mast there is no precise yardstick because there is no specification which the fabricator must meet.

Standard Derrick Loads

A brief summary of the loads which the standard derrick is designed to resist will furnish a basis for an appraisal of any drilling mast:

1. It must support a crown-block load equal to the fabricators rated capacity. More will be said on this subject later.

2. It must support a setback equivalent to the manufacturer's claims for setback capacity. This requirement implies that the structure will resist the horizontal thrust from the lean of the pipe.

3. It must resist the pressure imposed by wind blowing at a specified velocity.

In the case of the standard derrick the A.P.I. Standards specify the amount and direction of the wind and the formula for determining its pressure in pounds per square foot. Also specified is the condition that wind pressure shall be provided for with the setback standing in the derrick.

Although the A.P.I. has not set up standards to cover unguyed masts we are not without a proper guide. The oil industry has set up the A.P.I. committees to insure uniformity of practice and many of the specifications that have been developed to cover the design of standard derricks are equally applicable to the proper rating of masts.

One such specification is A.P.I. Standards 4, Section VIII, covering allowable stresses. This specification recognizes structural grade steel, A.S.T.M. A7; silicon steel, A.S.T.M. A-94; and Class C seamless pipe. In A.P.I. committee meetings, during discussion of masts, the subject of materials has received considerable study and new standards have been proposed and are under consideration. It is reasonably certain that any additional recognition, either of other materials or stresses, will be in line with past A.P.I. practice—conservative and in accord with recognized structural practice.

Materials discussed and given tentative recognition are Cor-Ten and Man-Ten, both high-strength steels. Specifications considered for adoption include working stresses based on the yield point. Silicon steel A.S.T.M. Specification A-94 is included with these steels in a group having a minimum yield point of 45,000 psi.

In the case of both Cor-Ten and Man-Ten the yield point varies with the thickness. For a thickness of ⅝ in., commonly used in masts intended for deep work, the advantage of Cor-Ten or Man-Ten over silicon steel is approximately 4 per cent.

Determining Mast Capacity

Since there is no uniform method for determination of mast capacity by manufacturers, it is important to the user that he be able to rate masts comparatively. To do this he must determine:

1. Is the crown block load so placed that all legs are equally loaded?

2. If not equally loaded, what proportion of the load is carried by front

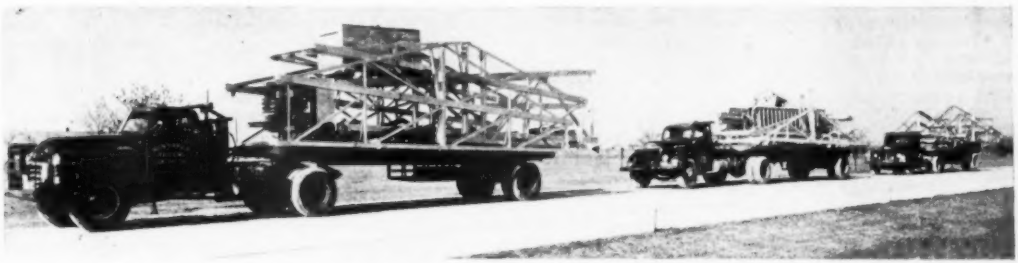

Fig. 1—Typical portable-type mast and associated equipment is shown here being transported on three trucks

legs and what proportion on rear legs?

3. What is size of front legs?

4. What is size of rear legs?

5. At what intervals are legs supported by girths or other bracing?

6. How adequate is this leg support? Obviously the greater the unsupported span of the leg the less the leg capacity and the more definitely the leg is supported the greater its capacity as a column.

The resistance to horizontal loads can best be determined by questioning the fabricator. Since we are limiting this discussion to unguyed masts the following points should be clarified:

1. Amount and weight of pipe setback that the mast will support.

2. Wind velocity that the mast will withstand with no setback on the floor.

3. Wind velocity that the mast will withstand with full rated setback standing on the floor.

4. Is the quoted wind velocity "actual" or "indicated"?

5. Direction of wind on which rated velocity is based.

Until recently A.P.I. specifications provided for resistance, with a specified setback standing, to an indicated wind velocity of 70 m.p.h. It was discovered that many operators were misled by this rating. Weather Bureau reports are currently based on actual wind velocity and operators very naturally assumed that an A.P.I. derrick would withstand actual winds of 70 m.p.h. and were disappointed when they learned that provision for only 54 m.p.h. was provided.

Wind Load Rating

To correct this situation the A.P.I. specification has been changed to 54 m.p.h. actual velocity. If the rating is for an "indicated" wind load it must be reduced to avoid confusion. Indicated wind velocity exerts a pressure of $.0024V^2$ lb. per square foot of exposed surface while actual wind velocity exerts a pressure of $.004V^2$ under A.P.I. Standards. In these formulas V = velocity of the wind in miles per hour. The difference will be further clarified by calculating the pressures for 100-m.p.h. winds. If the 100 m.p.h. is an indicated velocity the resulting pressure is $.0024 \times (100)^2 = 24$ lb. per square foot. If the velocity is actual the resulting pressure is $.004 \times (100)^2 = 40$ lb. per square foot.

It is obvious from the above that a mast having a specified rating as to wind resistance of "100 m.p.h. indicated velocity" is actually capable of resisting only 60 per cent as severe a wind load as a mast rated for "100 m.p.h. actual velocity."

To appreciate the significance of the fifth condition a brief discussion of the effect of varying the direction of the wind is in order. A.P.I. Standards No. 4, page 33, reads in part, "The unit wind load shall be considered to be applied to the exposed area of two directly opposite sides of the unboarded derrick and also to a setback of pipe assumed standing within the derrick." This specification clearly assumes that the direction of the wind is perpendicular to a face. In a standard derrick all four faces are made alike above the V window; hence, provision is made for a direction of wind perpendicular to any face. Actually this direction of the wind results in maximum stresses in the lace work but does not result in maximum stresses in legs, leg splices, or anchorage parts.

Fig. 2—A portable mast rigged up at a well in a West Coast drilling operation

A tentative A.P.I. specification, intended to correct this oversight, provides that the legs and anchorage parts be designed for the direction of the wind which will cause the maximum stress in those parts. In the case of a standard derrick this direction will be, for a derrick with no setback standing, with the wind blowing at an angle of 45° with the derrick face. The condition that will impose maximum stresses in the legs of a mast, with no pipe standing, is with the wind blowing in a direction parallel to a line through two diagonally opposite legs of the structure.

Although advance notice of severe hurricane winds is probable, winds of considerable magnitude, the velocity depending on the geographical location, will occur with insufficient warning to permit of laying the pipe down or going in the hole; hence, the necessity for providing for wind resistance with setback standing. Weather experts estimate that such sudden storms may result in as much as 75 m.p.h. actual wind velocity in the gulf or in coastal areas. For exposed locations resistance to severe winds with setback standing should be checked.

Unguyed masts, as previously stated, are designed to stand and to support the pipe setback without guys. Substructures, or bases, for masts are usually narrower than bases for standard derricks and for that reason they are less stable. Not infrequently masts are guyed in exposed areas not to support the mast against structural failure, but to prevent the overturning of the complete rig. Because of this practice there is a tendency to give little attention, in the selection of a mast, to its ability to resist wind stresses with setback on the floor. In the case of a barge or platform installation there is no convenient place for guy anchors and there is no danger of the rig overturning, so dependence must be placed on the mast structure to withstand the loads imposed by wind against mast and setback.

A study of the effect on the mast of wind pressure on the structure with setback standing, raises a question regarding resistance to torsional stresses. Such stresses will result if the wind is perpendicular to the narrow face of the mast especially if pipe is racked outside the structure.

PRIME MOVERS

Internal Combustion Engines*

MORE than half of all the rotary rigs now in operation in this country are powered by internal-combustion engines using gas or butane as fuel. The remainder are divided among steam, diesel-mechanical, diesel-electric, and purchased-electric-power rigs. This predominant position as a prime mover of rotary rigs has been attained by the internal-combustion engine in the relatively short time of less than 20 years. The progress has been primarily at the expense of the steam rig. Contributing causes were the economy of operation as far as fuel and water consumption is concerned, and increased portability of a power rig as compared with a steam rig. The disadvantages resulting from inherent characteristics of internal-combustion engines have been overcome to a considerable extent by providing means for proper transmission of power to different component parts of the rig.

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*Joseph Zaba, chief mechanical engineer, Stanolind Oil & Gas Co.

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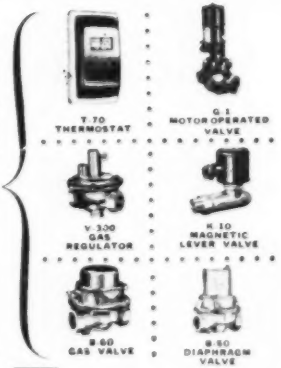

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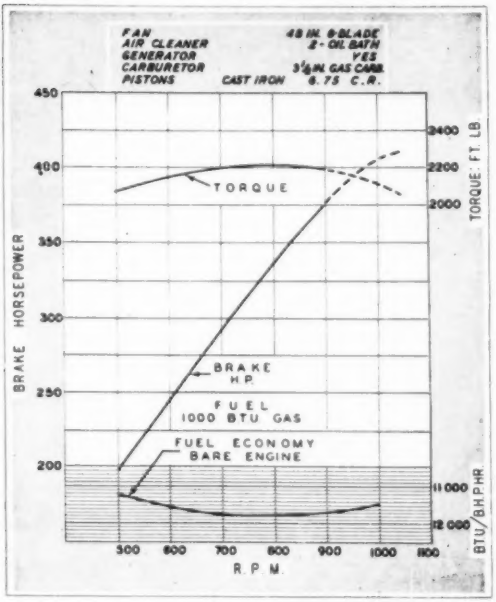

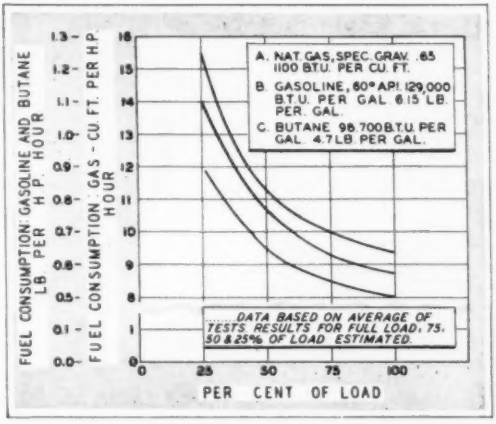
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B. GASOLINE, 60° API 129,000 B.T.U. PER GAL. 6.15 LB. PER GAL.
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DATA BASED ON AVERAGE OF TESTS RESULTS FOR FULL LOAD, 75, 50 & 25% OF LOAD ESTIMATED.
FUEL CONSUMPTION: GASOLINE AND BUTANE LB PER H.P. HOUR
FUEL CONSUMPTION: GAS - CU. FT. PER H.P. HOUR
PER CENT OF LOAD

Fig. 1—(Left) Power, torque, and fuel-consumption characteristics of a typical internal-combustion engine

Fig. 2—(Above) Fuel consumption of gasoline, natural gas, and butane in internal-combustion engines

creasing depth of wells have been met by increasing the size and the number of engines used. There have been no radical changes in the design of drilling engines during the last few years. The improvements made were primarily in the type of materials used and in details of design. A modern internal-combustion engine, used in rotary-drilling service, is designed to handle the rapidly changing load demands and to withstand severe conditions of oil-field hauling and moving, and requires a minimum of attention and maintenance. It is conservatively rated with a resulting long operating life. Fig. 1 gives power, torque, and fuel-consumption characteristics of a typical large internal-combustion engine used for drilling operations.

Means of compounding of individual engines are provided in a power rig, permitting any desired distribution of the total power among the different portions of the rig or concentration of all the available power for any one operation. From the standpoint of the prime mover itself, compounding requires synchronization of the compounded engines, if efficient distribution of loads is to be attained. If the speeds of the individual engines are not closely synchronized, one of the engines may be overloaded and may actually have to pull another engine or engines.

To attain engine synchronization, use may be made of the engine intake-manifold vacuum. This vacuum is an approximate indication of the percentage of load that the engine is carrying. Special throttles have been developed using manifold vacuum for proper distribution of load among two or more engines. Arrangements must be made for a system which permits selective synchronization of the engines. For instance, in drilling, one of the engines may drive the rotary at a different speed from the two other engines which are synchronized and compounded to drive the mud pump. Then in hoisting all three engines may be compounded and their speed must be synchronized.

Fig. 2, based on data of one engine manufacturer, gives fuel consumption of internal-combustion engines for different fuels and different percentages of loading.

Supercharging and Dual Fuel*

BOTH turbosupercharging and dual-fuel operation have been supplied successfully to diesel engines for mechanical drilling-rig drives. These two independent features further widen the field of application of the increasingly popular diesel drilling engine.

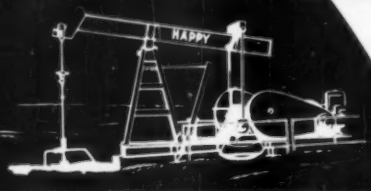
Supercharging greatly increases the power output of the engine with little increase in weight. Dual-fuel equipment permits conversion from oil to gas operation by the movement of a single lever while the engine is running — and the gas is burned more efficiently than in the conventional spark-ignition low-compression gas engine.

Field testing has demonstrated fully the practicability of both supercharging and dual-fuel operation under severe drilling conditions. Although gas operation was not required during testing, dry residue gas of about 1,050 B.t.u. was supplied for test purposes. One of the principal objectives of this field test was to demonstrate the flexibility and fast getaway of the dual-fuel supercharged engine under actual drilling conditions. Continuous load-carrying capacity and fuel economy have already been established in other applications. The conventional diesel engine has the advantage of faster acceleration than the spark-ignited gas engine although this latter engine is regarded as highly satisfactory for drilling power.

With the diesel, the response of the fuel system to a throttle advance is almost instantaneous, the increased quantity of fuel oil entering the cylinder practically the next revolution. In the spark-ignited gas engine a small interval of time elapses after the throttle advance while a new set of conditions is being established in the intake system.

The supercharged test engine, op-

*G. F. Noltein, chief engineer, Superior Engine Division of The National Supply Co



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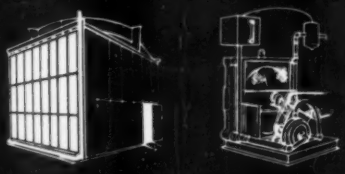

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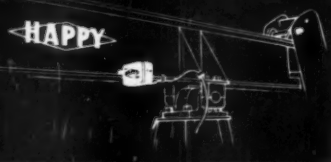

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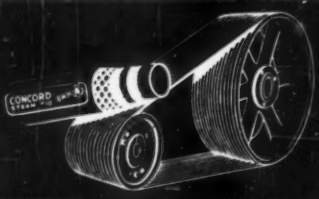

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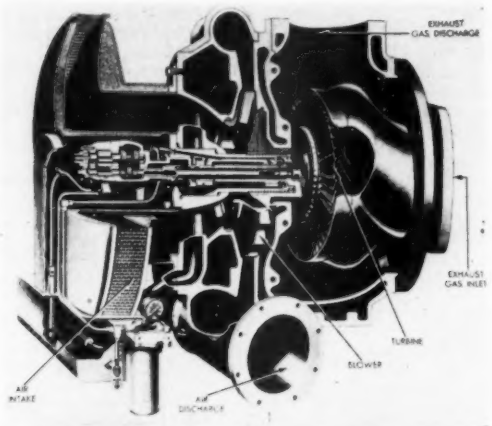


Fig. 1—(Above) Cutaway view of a modern turbosupercharger used on a diesel engine

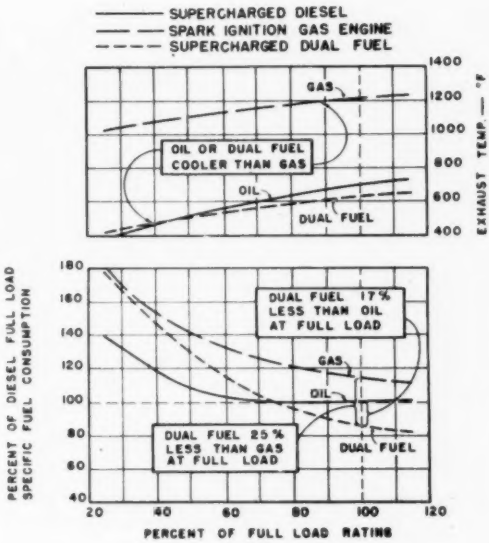


Fig. 3—(Right) Comparative fuel-consumption curves for various combinations of gas and diesel fuel and exhaust temperatures at various percentages of full load. Economies afforded by the dual-fuel system are shown

erating on fuel oil or on dual fuel, gave very satisfactory rig performance, responding snappily and rapidly accelerating either the drill pipe or the empty blocks. The turbocharger introduced no element of lag in the rig performance.

This test also confirmed the anticipated fuel economies of the new engine which are shown graphically in Fig. 3.

Reduction in weight is always an advantage, but it is a most important consideration in connection with the trend towards the large drilling rigs. Supercharging increases the power output of the engine about 60 per cent with an increase in weight of only about 15 per cent. The weight per horsepower is reduced about 40 per cent.

Supercharging increases the combustion capacity of the cylinder in two ways. First, at the end of the exhaust stroke the blower scavanges the hot residual gas otherwise left in the cylinder and replaces it with undiluted cool fresh air; second, it fills the cylinder with air under supercharging pressure. This increased quantity of air furnishes oxygen for the combustion of a greater amount of fuel.

Increased power is obtained with only slight increase in cylinder pressure during the power stroke. This higher average pressure is possible in the supercharged engine cylinder because the additional fuel is burned with the same relative effectiveness as in the naturally aspirated engine. Furthermore, this additional power is developed with negligible increase in crankshaft and connecting rod bearing pressures.

Little additional cooling capacity is needed because considerable heat is dissipated by the scavenging air which blows through the cylinder and cools the cylinder head, cylinder walls, valves, and piston.

The supercharging of the diesel drilling engines covered here requires: (1) a turbosupercharger, (2) a special divided exhaust manifold, (3) special valve timing, (4) oil-cooled pistons, and (5) a larger lubricating-oil pump. These changes involve so many parts that it is neither economical nor practical to add superchaging to an engine already in service.

The turbocharger is a simple self-contained unit, composed of a gas turbine and a centrifugal blower mounted on a common shaft. The exhaust from the engine power cylinders passes through the turbine on its way to the atmosphere. The turbine makes use of some of the exhaust energy, otherwise wasted, and this salvaged energy drives the blower. The blower in turn supplies all of the scavenging and combustion air, at a pressure above atmosphere, through the conventional air-intake manifold.

A special exhaust manifold with multiple passages transmits the ex-

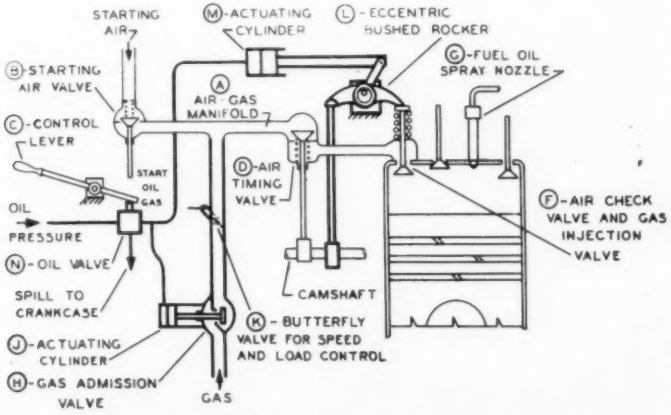


Fig. 2—Schematic diagram of controls for dual-fuel operation

haust from the cylinders to the turbine nozzles with a minimum of interference from the several cylinders.

There is no connection between this blower and the engine crankshaft. No control equipment is necessary as the speed and output of the turbocharger vary automatically with the speed and load, of the engine.

Dual-Fuel Operation

Dual-fuel operation offers a simple solution to a fuel problem which has troubled drilling operators for many years. Heretofore it has been impossible to obtain in one convenient package a diesel engine which could burn fuel oil at highest efficiency and yet take advantage of free or low-priced gas when this fuel was available.

The dual-fuel engine offers in one compact unit the ability to burn either oil or gas on the high-compression diesel cycle, at highest thermal efficiencies, and with most favorable response to the throttle. It adds about 10 per cent to the cost of the engine and a negligible increase in weight. It can be added either to the supercharged or to the naturally aspirated Superior engine at any time.

Fundamentally the dual-fuel engine substitutes a portion of gaseous fuel mixed with the combustion air for a corresponding portion of the liquid fuel. The engine continues to operate on the diesel cycle with compression ignition. It has been demonstrated that gas will not ignite regularly under the compression pressures and corresponding ignition temperatures used in conventional diesel engines. Therefore, in gas operation it is necessary to provide a certain proportion of oil as a pilot fuel for igniting the gas. This is actually beneficial as it provides excellent control over gas operation.

Although lesser amounts of pilot fuel can be used under laboratory conditions, under the intermittent operation of a drilling engine it is necessary to use a fixed quantity of pilot oil equivalent to 10 to 15 per cent of full-load oil consumption. Thus on gas operation the gas consumption will vary from a few per cent at idling loads to about 87 per cent of the total fuel at full load. The actual ratio and the economy of the gas operation will vary accordingly with the loading of the engine.

On the variable-speed drilling engine it has been found both simple and convenient to provide for only two fuel conditions: (1) full fuel-oil operation and (2) dual fuel with pilot oil and maximum gas. Variation in available gas can be accommodated by running some engines on dual fuel and the remainder on oil. In contrast, on stationary installations a more involved governor automatically handles a wide and varying range of oil to gas ratios.

The supercharged engine presents a special problem in the introduction of gaseous fuel. It cannot be introduced directly into the intake manifold as in the case of the naturally aspirated engine because the supercharged engine blows a portion of this air through the cylinder at the end of the exhaust stroke for scavenging purposes and this would carry with it some of the premixed fuel.

In the supercharged engine the gas must be injected into the cylinder under pressure after the scavenging is completed and the exhaust valve has closed. The supercharged engine described has a novel gas-injection system using the starting-air check valve already in the cylinder for the injection of gaseous fuel, thus giving interchangeability of heads between diesel and dual-fuel engines.

Either starting air or fuel gas can be admitted selectively to the air-gas manifold. When the control lever (C) (Fig. 2) is moved in the starting direction, starting air pressure is admitted to this manifold. During this operation gas valve (H) is closed, the hydraulic actuated eccentric bushing (L) has made the cam control of air check valve (F) inoperative allowing it to act simply as a spring-loaded check valve and the high air pressure had forced the timing valve (D) down against the camshaft to time the admission of starting air to the cylinder.

After the engine is started, the control lever is moved to an intermediate position where there is neither starting air nor gas in the manifold and the engine operates on oil.

If it is desired to operate on dual fuel, the control lever is moved farther, opening the oil valve (N) which actuates the hydraulic cylinders on the gas-admission valve (H) and the eccentric bushing (L). Gas is now admitted to the starting air manifold where it is controlled by the butterfly (K) and the injection valve (F). The air-timing valve remains open because the gas pressure is not sufficient to force it down on the cam against the action of its spring.

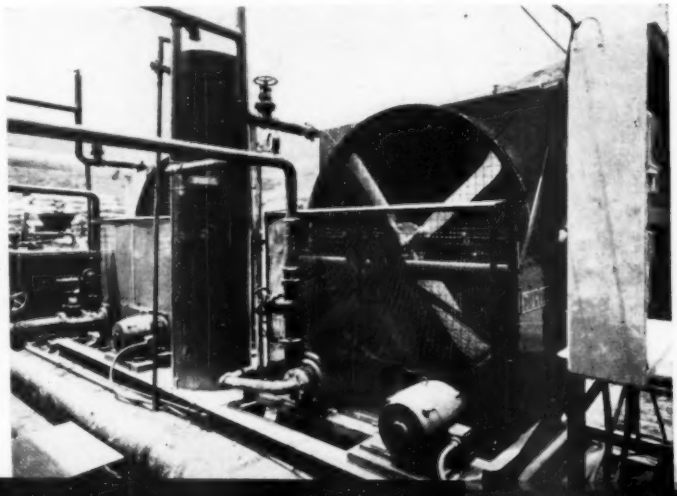
Fig. 3 shows an interesting comparison of fuel consumption of the supercharged dual-fuel engine as compared with the straight diesel and the conventional spark-ignition gas engine. These comparisons are on the basis of B.t.u. content of the fuel per brake - horsepower - hour. Of course the economics of drilling fuels depend on the cost of gas and oil and the cost of gas particularly may vary over a wide range.

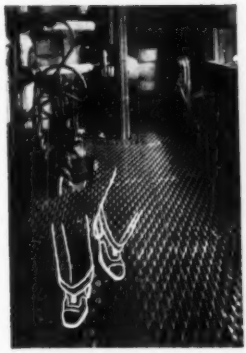
Central Cooling

THE principal objection to separate coolers for drilling-engine water in the past has been that they constitute another piece of equipment to be moved. There are, however, advantages offsetting this point.

Principal advantage is the power savings in fan loads. Taking a case where ten 150-hp. engines are used, perhaps an extreme example, and assuming several horsepower fan load per engine if fans were on the engines, this would release a substantial amount of horsepower to apply to the drilling rig. The separate cooler, in contrast, uses only eight fan horsepower. The cost of the engines in terms of "cost per horsepower" is thus substantially reduced. Naturally the cost of the separate coolers has

Central installation for cooling water from engines and auxiliary brakes





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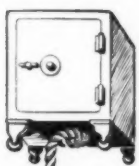

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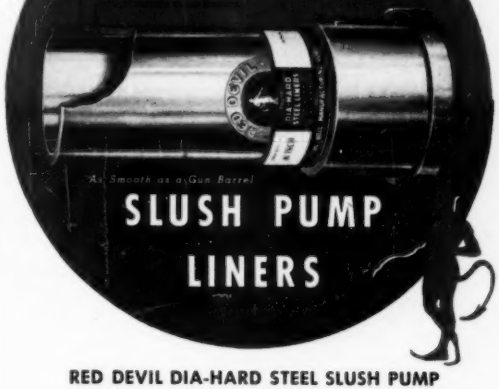

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to be considered in the over-all cost consideration, but the point is that more horsepower is available for the rig, and the cost of the separate coolers is largely offset by omission of engine radiators and fans.

The removal of the cooling units from the rig means a removal of a great deal of heat within the rig, which often is an objectionable feature on engine-powered rigs. The engine radiators do not have access to unheated air, frequently at least, and the heat is objectionable to the crews in hot weather.

Use of the separate coolers, located outside the rig, also removes the noise of high-speed fans from the rig. Elimination of the engine fans makes possible more efficient maintenance of the engines because the mechanics can detect engine noises and locate trouble more efficiently without fan noise and the fan blast passing over them while working.

By having water pumps on the separate coolers, a constant flow of water can be distributed to all engines regardless of engine speed and engine-pump performance. This, together with automatic shutter use on the separate coolers, obtains an abundant water supply to all engines at a constant temperature, resulting in lower temperature rise through the engines.

The separate coolers can be tied in to the cooling circuit of either the hydromatic or electric draw-works brakes, thus dispensing with cooling tower or with other cooling equipment used for that purpose.

Hydraulic Drives*

FUNDAMENTALLY, there are two distinct divisions of hydraulic drives; namely, the positive displacement or hydrostatic unit depending up on fluid pressure to transmit the power, and turbo or hydrokinetic unit depending upon fluid velocity to transmit power. The positive-displacement units, such as pumps and fluid motors, have not, as yet, made their appearance to any great extent in the oil fields, and therefore this discussion will be confined to the turbo type of unit in its various forms.

The hydraulic coupling and the torque converter are the two fundamental forms of the turbo or the hydrokinetic drive units. Both depend upon the ability of fluid to absorb and then release kinetic energy in the form of increased and decreased velocity. The fluid circuits of both couplings and converters are annular or doughnut-shaped chambers, because in such forms the circuits have greatest compactness and lowest fluid frictional losses.

*H. A. Davis, Twin Disc Clutch Co. Summarization of paper presented at meeting of Petroleum Division, A.I.M.E., Dallas.

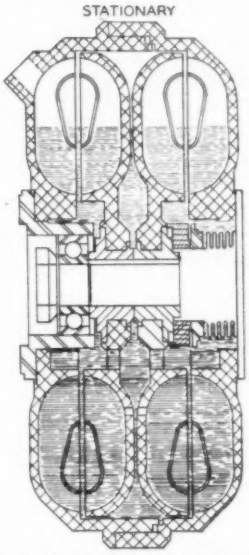

Fig. 1—Double-circuit hydraulic coupling

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The coupling has but two principal parts, the impeller and the runner, while the converter has three principal parts, the centrifugal pump, the turbine, and the reaction member which is attached to the housing. In both units, the impeller, or pump, picks up the fluid at the center and imparts to it kinetic energy in the form of increased velocity as it travels outward radially. The fluid then passes through the runner or turbine, as the case may be, giving up its velocity or energy as it returns inward radially.

In the case of the coupling, this kinetic energy is transmitted as unit torque with frictional losses becoming evident as slip, or lower output speed. The converter fluid circuit differs at this point from the coupling in that the fluid upon leaving the turbine blades, then passes through the reaction member blades which changes its direction of flow. Since the reaction blades are stationary and are attached to the housing, the resulting torque force due to redirection of the fluid is actually added to the input torque, resulting in an increased output torque; for, as is well known, in a balanced system input and output torque forces must total zero.

The capacity for transmitting torque and horsepower for both hydraulic couplings and the converters is based upon well-known hydraulic laws and can be expressed as: Torque capacity is proportional to the square of the speed. Horsepower capacity is proportional to the cube of the speed. Both the torque and horsepower are proportional to the fifth power of the circuit diameter.

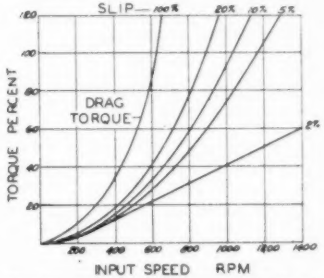

Fig. 2A—Slip curve for double-circuit coupling

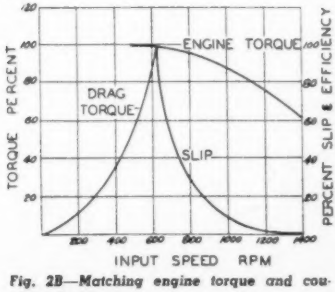

Fig. 2B—Matching engine torque and coupling slip curves

Traction or Constant-Speed Coupling

The first and simplest form of the hydrokinetic unit is the plain hydraulic coupling of the traction, or full-fill type. Fig. 1 shows the double-circuit coupling in the stationary non-running condition. This coupling is generally filled to a definite level allowing only sufficient air space to accommodate the fluid expansion while working. This coupling operates equally well in either forward or reverse rotation, and insofar as its ability to transmit power, either the impeller or the runner may be attached to the power source. However, for practical reasons of heat dissipation, it is most common to attach the input or power source to the impeller which causes the entire coupling outer housing to rotate, thereby offering greater heat dissipation.

A typical slip curve for this type of coupling is shown in Fig. 2 (a) where the percentage of output slip is indicated for any input torque and speed within the limit of the coupling size.

In selecting a coupling to match any particular size of engine, it is necessary to impose the engine's

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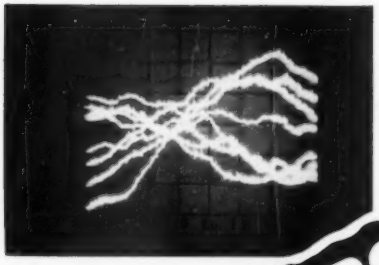

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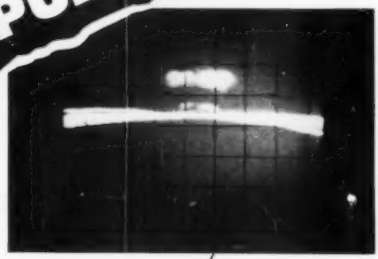

AFTER INSTALLATION OF ACCUMULATOR
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Pressure surges and pump pulsations are the two most common causes of pipe lines and hydraulic system failures. Surges and pulsations, however, can be greatly minimized or eliminated by installing a Greer Accumulator in the system. A simple "T" connection is all that is necessary to install it in any existing or newly designed circuit.

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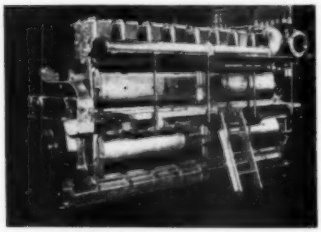

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torque curve on the above mentioned slip curve, then the performance characteristics can be drawn as presented in Fig. 2 (b). However, for a successful application, consideration of the required operating loads and speeds must be made in order that the coupling slip at continuous operation speed shall not exceed the capacity of the coupling to reject the heat generated due to slip.

Generally, the magnitude of continuous slip which is allowable is in the range of 3 to 4 per cent. The characteristics of the coupling, as shown by the performance curve, are such that it allows the engine to start at practically no load and to come up close to its maximum torque before full load is imposed.

Since slip represents loss of power, it must be more than justified by the following stated performance characteristics: first, a coupling provides protection to the driven unit as against torsional vibrations from the engine; second, it prevents shock loads from being transmitted back to the engine; third, it prevents engine stall and dampens shock from flywheel when driven unit stalls; and fourth, it provides a means of starting heavy loads which would normally stall the engine or burn up the clutch before they could be brought up to running speed.

Scoop Tube or Variable-Speed Coupling

The scoop tube, or variable-speed coupling, is the simplest modification of the basic hydrokinetic unit. Speed and torque variations are obtained through the use of a scoop tube which provides the means of changing the quantity of oil in the working annulus. As shown in Fig. 3 (a) when the scoop is set for maximum dip, the idle oil in the rotating housing is at a maximum and the working circuit of the coupling is full. Under this condition, the coupling

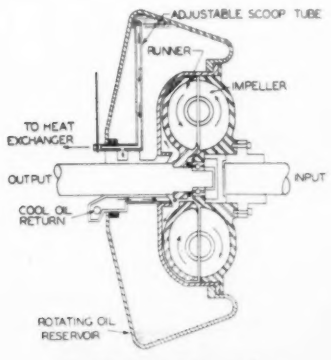

Fig. 3A—Scoop-tube coupling

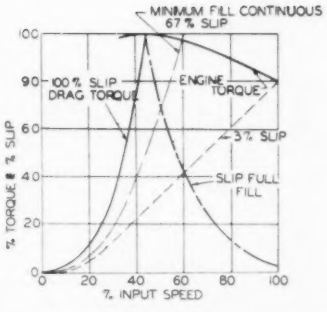

Fig. 3B—Operating characteristics of the scoop-tube or variable-speed coupling

performance is identical with the full-fill traction coupling and the output shaft will run at approximately 96 to 97 per cent of the engine input speed.

However, when the scoop is lowered, the working circuit oil bleeds off through the orifices until a balance is established between the oil picked up by the scoop and the rotating storage oil level. If the scoop is fully lowered no oil enters the working circuit of the coupling and the oil in the circuit immediately bleeds out through the orifices. In this case, the coupling acts as a cutoff clutch which completely disconnects the load from the engine.

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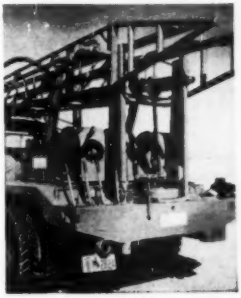
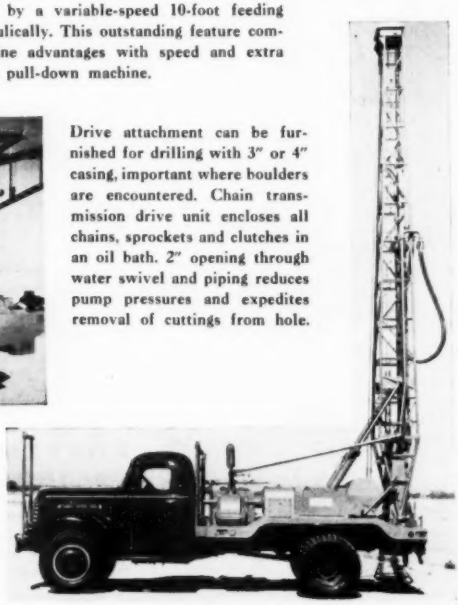


Drive attachment can be furnished for drilling with 3" or 4" casing, important where boulders are encountered. Chain transmission drive unit encloses all chains, sprockets and clutches in an oil bath. 2" opening through water swivel and piping reduces pump pressures and expedites removal of cuttings from hole.



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By varying the amount of oil in the working circuit, speed and torque variations can be accomplished in the range of 3:1 ratio for speed and 5:1 ratio for torque. Since the speed variation within the coupling generates heat due to slip, the scoop affords a method of removing the oil from the working circuit and forcing it through an external heat exchanger. The cool oil is then forced into the circuit, thereby allowing for continuous operation even at a relatively high slip ratio.

Oil-field applications of the scoop-tube-type of hydraulic unit to date have been limited generally to the larger power drilling rigs, mainly because of the initial investment required. Such applications, however, have proved entirely satisfactory and therefore additional installations can be anticipated.

Schneider Type Single-Stage Torque Converters

The next logical division of kinetic hydraulic units is the Schneider single-stage torque converter. This unit operates part of the time as a single-stage converter and the rest of the time as a coupling, thereby offering some of the operating advantages of both.

Fig. 4 (a) shows a cross-section of a typical unit in which there are three principal operational parts—the pump, the turbine, and the reaction chamber. All three parts are similar in construction and function to a single-stage converter insofar as the pump is attached to the input shaft and the turbine to the output shaft. However, the reaction member differs at this point since it is mounted on a free-wheeling clutch-type bearing which is located between the pump and turbine. The reaction member is the part which makes torque multiplication possible, since it is locked in a stationary position during periods when output torque demand is greater than input torque. The force which accomplishes this alternate lockup and breakaway is supplied by the direction in which the oil strikes the reaction member blades. The break-

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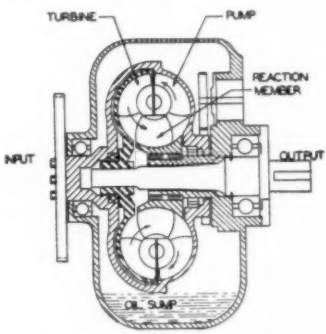


Fig. 4A—Schneider torque converter

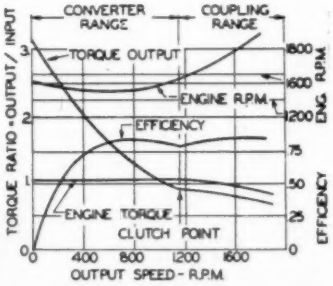


Fig. 4B—Torque-speed characteristics of the Schneider converter

away point is also known as the clutch point.

Fig. 4 (b) represents a typical performance curve for a Schneider type torque converter, showing two ranges of operation: the converter range of torque multiplication, and the coupling range of the unit torque output.

The clutch point where the reaction member breaks loose and rotates with the turbine is generally located at a speed ratio of 0.8 for most industrial applications. However, by circuit design modification the clutch point can be moved down to as low as 0.5 ratio if desired.

The converter may be called upon to operate for long periods of time at relatively low output to input speed ratios, thereby generating considerable heat due to turbulence, and for this reason it is necessary to continuously bleed off a portion of the oil in the circuit and force this oil through an external radiator or heat exchanger. The required capacity of the radiator or heat exchanger is dependent upon the application, and in some installations very little external radiation capacity is necessary.

Of all the hydrokinetic units, the Lysholm-Smith converter has the greatest over-all torque multiplication. The hydraulic circuit of this unit consists of a single-stage centrifugal pump discharging through a three-stage turbine, with two stages of reaction interposed behind the first and second turbine stages. Fig. 5 (a) shows the three basic parts; the pump which is a riveted fabrication of a hub, rim, and one set of blades indicated as (P); the turbine which is a riveted assembly of rims, shells, shroud, and three sets of blades indicated as (T1), (T2), (T3); and the converter housing or bowl, which is a contour machined casting in which two sets of reaction blades are riveted, indicated by (R1), (R2).

All parts of the converter are machined to reduce fluid turbulence to a minimum. The blade cross-sections are of the tapering air-foil type and are set at an angle to the fluid flow, with the trailing edge sloping backward relative to the direction of motion. Circumferential labyrinth seals are used between stages to prevent fluid from bypassing the working circuit. The oil is constantly being heated due to turbulence which makes it necessary to continuously run a small portion of the oil in the hydraulic circuit through an external radiator or heat exchanger. The capacity of the radiator is usually designed to handle a maximum 30 per cent of input horsepower.

Fig. 5 (b) shows typical converter performance characteristic curves as powered by an engine. The full lines indicate full-throttle operation and the dotted lines partial throttle operation. Maximum torque is developed at output stall and is approximately five times engine torque. Maximum efficiency of 85 per cent is attained at a speed ratio of approximately 0.5. Full throttle operation at low speed ratio, below the 70 per cent efficiency point, causes overheating, therefore the converter, for continuous duty, should be operated between 0.2 and 0.8 speed ratios.

Frequent intermittent operations outside this range are normal practice so long as they are spaced with ample time for cooling the unit. Partial throttle operation performance is very similar to full throttle performance except that it is reduced in magnitude, or speed.

In order properly to apply a converter to any engine and machine assembly, it is necessary to select the converter size so that full rated engine horsepower will be absorbed at a speed ratio of 0.7 to 0.8 and the drive ratios in the machine so designed that continuous operation occurs above 70 per ct. efficiency point.

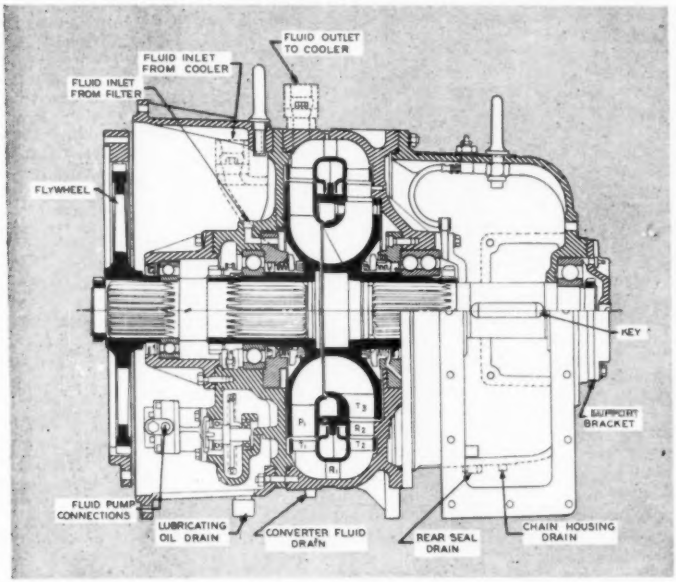


Fig. 5A—Three-stage hydraulic torque converter. Parts are labeled

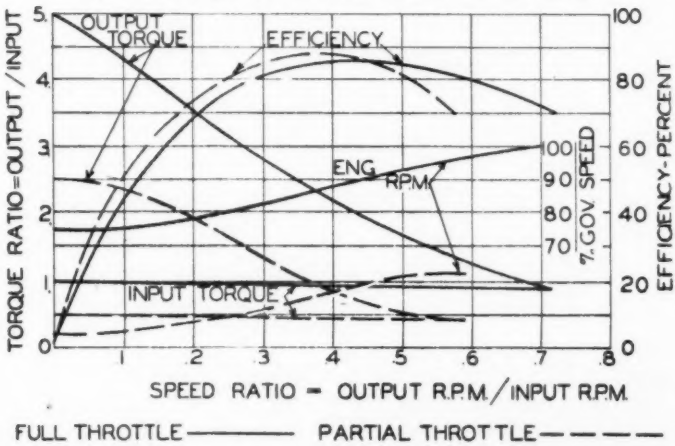


Fig. 5B—Torque, efficiency, and r.p.m. curves for the three-stage machine at full and part throttle

DRAW WORKS AND AUXILIARIES

Power Transmission*

TO a very great extent the improvements in drilling machinery have originated in the field, in the efforts of the operators to find solutions for their problems. Today we have probably outgrown that stage and improvements are more and more the results of organized study and research on the part of the industry's trade associations, manufacturers, and suppliers. The drilling-rig engineer, today, is definitely a specialist in a highly specialized field.

The last few years have seen a considerable development in drilling rigs with a tendency to break away from older conventional designs. Much of this development is due to efforts to adapt drilling machinery to the internal-combustion engine, some of it to the appearance of new forms of power transmission such as hydraulic and electric.

The class of light drilling and servicing rigs is probably the most highly developed. The medium and heavy-duty rigs have come in for much attention since the end of the war and are most active in development at the present time.

An oil-field drilling rig is basically a hoist with certain special features to adapt it to its function. All rigs have these features in common. The most important of them will be considered individually.

Transmissions

No prime mover available today can be used to power a drilling rig without the use of a variable speed transmission between it and the drum. The lifting capacity of even a small drilling rig is comparable with that of a large mine hoist. It must be portable. If it were not for this fact the much-discussed idea of a rig without gears or chains would be feasible. Steam mine hoists with the drum mounted directly on the crankshaft of a cross compound engine were standard in their day. There is no prospect at the present time of avoiding the use of high-speed prime movers and a variable speed-reduction gear.

The flexibility and speed range increases with the size of the rig. The following list represents, in a general way, current practice in type and range of transmissions.

Size of rig	Transmission range	Kind of transmission
Small	4 to 7½ to 1	Automotive type gear, hydraulic torque converter.
Medium	8 to 10 to 1	Special gear or chain, hydraulic torque converter.
	5 to 1	Steam rigs.
Heavy	10 to 12 to 1	Chain or electric.
	5 to 1	Steam rigs.

Because of the high torque of steam engines at low speed and full cutoff, less speed reduction is needed for them than for internal-combustion engines, and all of the reduction is in the transmission. In internal-combustion-engine rigs about 10 to 1 reduction is in the transmission and the rest, 3 to 5 to 1, is fixed.

The selection of variable transmission speeds or steps is important; this establishes the operating speed of the rig. It can be shown, theoretically, that transmission steps should be related to each other as 1/n, where n is the number of steps. This is a quite usual arrangement. With three or more engines on a rig, as is now very common, the function of the extreme low speed is rather for emergency use than for regular use. It is made low enough that the maximum rig load can be handled with one engine, under favorable conditions, or with two under any conditions. High speed is used for lifting the empty blocks and only in the largest rigs is enough horsepower available to do more than this in this speed.

On light rigs the use of automatic gear transmissions is common. These have over-all ratios of 4 to 7.5 to 1. Since the low-speed line pull fixes the capacity of the rig, their high-speed line speed is low. For this reason these rigs are usually slow. They will use from two to six lines in the derrick. Medium rigs are designed, as a rule, to use six lines in the derrick and their top line speeds are between 2,500 and 2,800 ft. per minute. Heavy rigs may operate with 6, 8, or 10 lines up and usually have top speeds of 3,000 ft. per minute or more.

Line pull will vary with the size and horsepower of the rig and will amount to 20,000 lb. or less in small rigs to 100,000 lb. or more in large rigs. Top line speeds will depend on over-all transmission ratio. A hook speed of around 400 ft. per minute is as high as can be used. This fixes the limit for the top line speed. Table 1 is an illustration of a solution of this problem as worked out for a 600-hp. rig.

Each successive step is about 1.52 times the next lower one, except third which is about 1.8 times fourth. This is a compromise between transmission ratios, over-all ratio and sprocket design. This enters the problem because of the need to maintain tight chains on the same center distances with various sprocket sizes.

This rig is recommended for 7,000 to 7,500 ft. depth. It will be noted that second speed has ample capacity to start the pipe out of the hole and sixth speed is as fast as can be used. The great bulk of the work of this rig will be done in third and fourth speeds.

The use of hydraulic transmissions, or torque converters, does not greatly change the problem of transmission design. This device requires fewer steps in the transmission, since a reduction of about 4 to 1 is inherent in the usual operating range of the torque converter. Since the transmis-

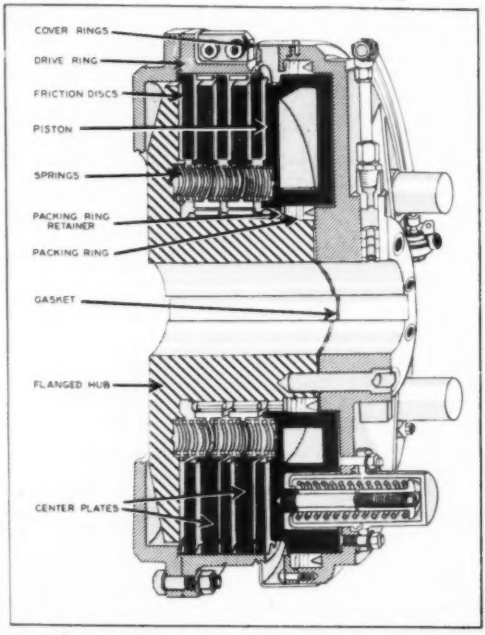


Fig. 1—Cross-section of a modern multiplate draw-works clutch

*William H. Griffith, special project engineer, International Derrick & Equipment Co., Columbus. Summarization of paper presented at Petroleum Mechanical Engineering Conference, Amarillo.

sion is installed between the torque converter and the drum, higher torques are handled. This calls for larger clutches and chains than in a transmission for a mechanical rig.

The use of electric power does not really substitute an electric transmission for a mechanical one, but rather substitutes an electric prime mover for the engines. Its advantages are more in control. Where electric power has been used on drilling rigs, it has usually been applied to an existing steam draw works. When electric power is to be used the draw works should be designed for the purpose and the transmission range and steps tailored to fit the motor characteristics.

Friction Clutches

It is not necessary to go back very far into the history of power-rig development to recall that clutch trouble was the greatest weakness that these rigs had to overcome. The friction clutches used by these rigs were cam operated and such clutches do not have a constant capacity. Multiple-disk clutches, cam operated, had insufficient clearances so that their plates often dragged and caused trouble. The effect of these conditions was that clutches frequently were operated when they needed adjustment, they slipped and they glazed the friction surfaces and they overheated. Add to this the frequent penetration of oil into the clutches which further reduced the capacity and you have an adequate explanation of the persistence of jaw clutch in drilling-rig transmissions. It is writer's conviction, and that of some of his associates, that the problem of satisfactory friction-clutch performance in drilling-rig transmission was simply one of proper clutch design and application, and that with modern oil-proof packing and oil-resistant lining now available friction clutches could be, and should be designed to operate in the oil spray of the rig transmission. This eliminates any danger of oil, that is unprovided for, getting into the clutch and reducing its capacity to a dangerous level. Accordingly a clutch was designed and a test program set up that would demonstrate the correctness, or the opposite, of these ideas.

It is obvious that a friction clutch must slip in picking up a load. Therefore a clutch that can start a load equivalent to the weight of the pipe in the hole at maximum rated depth, and can start this load at intervals of 1½ minutes for, say, 150 times without reaching harmful temperatures can be said to have reduced starting slipping to a safe and reliable minimum. A theoretical analysis of the problem resulted in data, in terms of load air pressure, coefficient of friction and constants of the clutch from which the slip, in terms of time or revolutions per minute could be estimated. The tests checked this analysis.

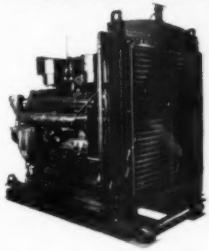
An examination of these clutches after drilling around 15,000 ft. shows no measureable wear on the friction surfaces and no glazing. It shows that the oil penetrates to all parts of the clutch and that it is beneficial rather than otherwise. A modern multiplate clutch is illustrated.

The use of a multiplicity of friction clutches in a rig presents prob-

TABLE 1—TRANSMISSION RATIOS FOR 600-HP. RIG. LINE PULLS AND HOOK LOADS BASED ON 70 PER CENT OVER-ALL EFFICIENCY. (80 PER CENT RIG EFFICIENCY LESS 2 PER CENT PER LINE)

Speed—	Ratio	Drum (r.p.m.)	Line speed (f.p.m.)	Line pull (lb.)	Hook load (lb. 6 lines)	Hook speed (f.p.m.)	Feet of pipe (20 lb./ft.)
Low	1:9.76	49	269	62,500	309,000	45	15,450
Second	1:6.45	74.5	409	41,200	204,000	68	10,200
Third	1:4.29	114	626	27,400	133,200	104	6,660
Fourth	1:2.33	206	1,130	14,900	73,800	189	3,690
Fifth	1:1.53	314	1,725	9,760	48,300	287	2,415
Sixth	1:1	478	2,625	6,400	31,800	436	1,590

Fewer Breakdowns!!!



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Longer life is assured with the new "FLEXO" cord construction because it eliminates the principal cause of rotary hose failure—the cutting action of threads in the fabric carcass against each other under torsional twist. The individual plies of cord are laid parallel to eliminate this cutting action and are protected from each other and from the cables in the pressure element by layers of rubber.

Greater strength results from the new construction because cord is much heavier and stronger than the fabric it replaces. Also, internal stresses are minimized by laying the cord carcass at exactly the same angle as the pressure element cables.

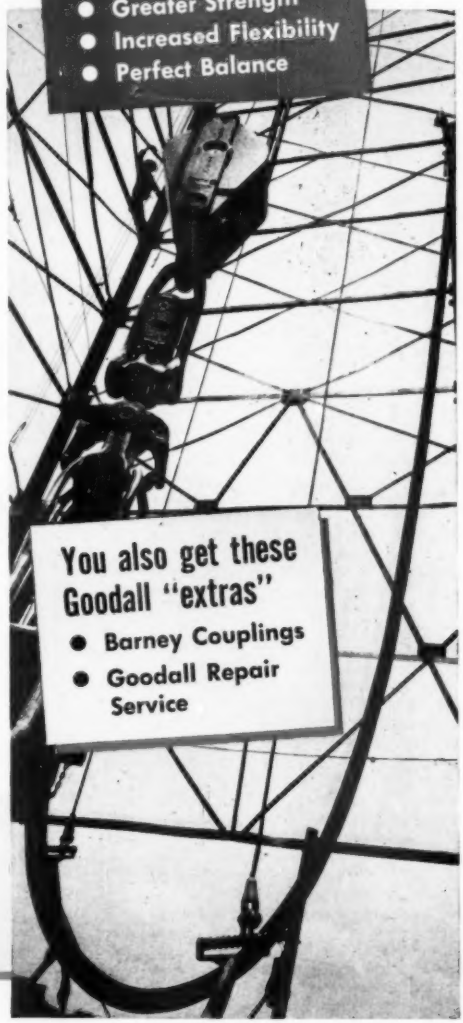
Increased flexibility—even superior to the famous Long-Life "FLEXO"—is produced by cord construction and contributes to longer life and easier handling.

Perfect balance, the result of uniform tension throughout the entire length of the hose, makes "FLEXO" handle naturally—without distortion—and resist the tendency to twist or elongate under pressure.

Extensive field tests under severe drilling conditions have proved that the new "FLEXO" Rotary Hose with cord construction withstands maximum pressures and heavy punishment far longer than any other hose.

ADVANTAGES

- Longer Life
- Greater Strength
- Increased Flexibility
- Perfect Balance



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lems in control. The levers required for manual clutch operation and for shifting jaw clutches were bad enough, but there were only a few. They would be impossible where six or more clutches are involved. Even the control of individual clutches by independent air valves is not desirable, because of the difficulty of selecting the right lever at the right time when the driller's mind is occupied by operating problems. Fortunately air lends itself readily to group or combined controls, so that a single lever or hand wheel may control all the operation of all the transmission clutches.

Auxiliary Brake*

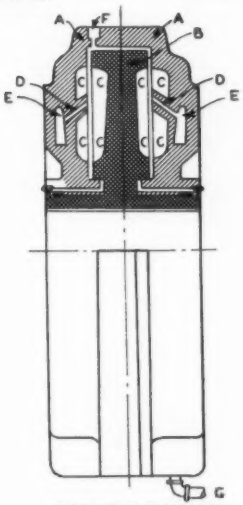
MODERN draw works recommended for 6,000-ft. drilling are equipped with two water-cooled friction brakes which average 43 in. in diameter by 8-in. face and 15 sq. ft. total circumferential area. Specifications generally list a supplemental energy absorption-type brake as optional but specifically recommend its use for depths of about 5,000 ft. For this size rig and to hold mechanical-friction-brake operating temperatures between 400° and 500° F., 4,250 to 4,500 ft. is the maximum depth to which pipe should be run in without the use of a supplemental energy dissipator.

It is important to point out that during the 15 seconds of actual running-in time for a stand of pipe, and during which time all the energy is converted into heat by the brakes, only about 20 per cent of the heat is actually conducted to and carried away by the cooling water. The remainder, approximately 80 per cent of the heat, is stored in the rim with the result that there is an appreciable increase in rim temperature. The remaining 45 seconds of the round trip are required for this stored heat to be conducted to and carried away by the cooling water with an accompanying decrease in rim temperature.

For the 4,250-ft. stand and a surface rim temperature at the start of 382° F., the temperature will increase to 494° F. by the time the stand is run in and then drop back to about 382° F. before the next stand is run. The high rim temperature itself, averaging 438° F. at 4,250 ft., is required to provide the necessary temperature differential for conducting the heat from the friction surface to the cooling water. As the weight of suspended load becomes greater and the energy to be dissipated increases, the temperature must also increase.

Friction brake lining is made up of asbestos, a filler, and a binder. If

*R. Griffin De La Mater, Parkersburg Rig & Reel Co.



FRONT ELEVATION

LEGEND

A - STATOR
B - ROTOR
C - STATOR AND ROTOR POCKETS
D - NOZZLES
E - SIDE WALL CHAMBERS
F - WATER DISCHARGE
G - WATER INLET

Fig. 1—Cross-section of a hydraulic-type draw-works brake. It is commonly called a hydrodynamic brake

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asbestos, a fibrous crystalline-form magnesium silicate, is heated to 500° F. for sustained periods, or subjected to higher temperatures for shorter periods, its water of crystallization distills off, thus reducing it to a white dust. Temperatures of 500° F. will also cause oxidation and deterioration of organic binders and generally adversely affect the frictional characteristics of the lining.

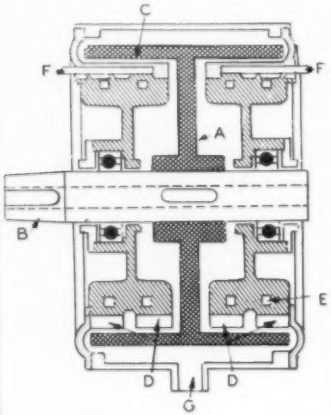


Fig. 2—Electrodynamic brakes also must have a water-circulating system for heat dissipation. The cross-section above is typical of the electrodynamic brake

Draw works now recommended for 12,000-ft. drilling are equipped with two mechanical friction brakes averaging 54.7 in. in diameter by 10.5-in. face and 25 sq. ft. total circumferential area. In addition to the mechanical brakes these draw works are universally equipped with a supplemental dynamic energy dissipator. With this size rig and under normal conditions of operation, 6,500 ft. is the maximum depth to which pipe should be run in without the use of the supplemental energy dissipator.

For average conditions of operation, assuming 15 seconds for lowering a 90-ft. stand and 1 minute per round trip, and a buoyancy factor for the mud of 0.85, the maximum ratio of hook load (air weight) to drawworks brake rim area is 5,900 lb. per sq. ft.

Dynamic Energy Dissipators

There are two basic types of dynamic energy dissipators, the "hydrodynamic" and the "electro (eddy current) dynamic." Both types may be driven from the drum shaft in essentially the same manner and both develop resistance only when in motion. Neither of the two types can actually stop and hold a load, functions implied at least by the term "brake," and consequently neither type can entirely replace the regular mechanical friction brakes. Beyond these points their characteristics are generally quite different.

Hydrodynamic Type

With the hydrodynamic type, resistance is created exclusively by fluid friction and agitation of water circulated between the veined pockets or rotor and stator elements. The conversion from mechanical energy to heat takes place directly within the water itself. Water required is generally supplied by the regular service pump for the rig. During the running in of a stand, and while revolving in the direction to create resistance, this type induces its own continuous inflow of fresh, cool water to displace the heated fluid. As a consequence the energy is dissipated at the same rate it is generated by the descending load. It is not necessary for the brake to be rotated while raising the empty blocks. Nor in any case is water circulation required during that period.

The resistance at any speed is adjustable by regulation of the volume of water being circulated through the veined pockets of the rotor and stator. Depending upon the type of installation, infinitely close regulation or regulation in any desired number of steps may be obtained by simple valve arrangements to vary the rate of flow or vary the head of water in a supply standpipe.

For any setting of the resistance control the horsepower capacity increases approximately in proportion to the cube of the speed; for example, if the speed is doubled the horsepower resistance is increased eight times. In starting from rest or while in operation the resistance is immediately responsive to any change of speed or setting of the resistance control. However, for any sudden appreciable change in either there may be a time lag of as much as 1 or 2 seconds during which the water circulation and attending resistance rapidly but smoothly reestablishes itself.

If for any reason the water supply should be cut off during the running-in period, the water in the casing, until completely evacuated, will keep the speed sufficiently in check to give ample time for the mechanical brakes to be applied.

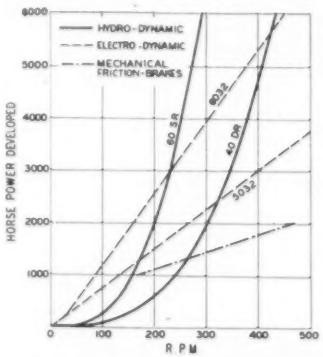


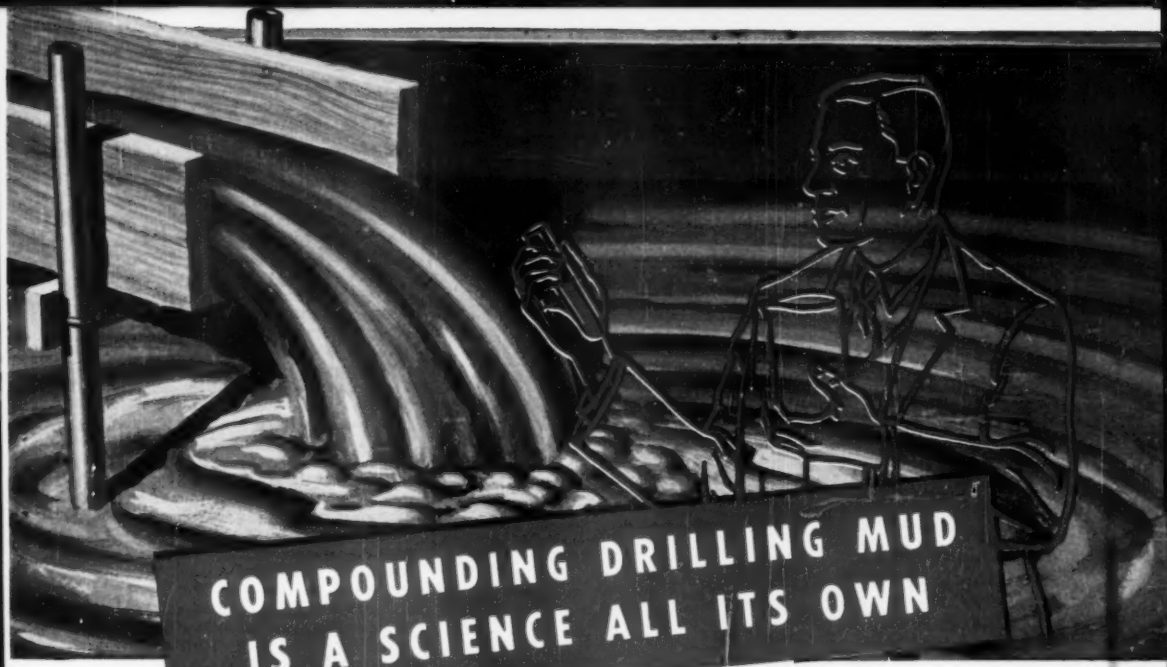
Fig. 3—Speed-horsepower characteristics of two approximately comparable sizes of auxiliary brakes. Solid lines represent the hydrodynamic brake, long dashed lines the electrodynamic type, and alternate long and short dashes represent the conventional mechanical type

Electrodynamic Brake

With the electrodynamic type, resistance is created by eddy currents produced by rotating an iron armature drum through the magnetic field of stationary electromagnets. The heat thus generated at the surface of the drum is dissipated by convection to the cooling water circulated around the coils and drum. To effect this heat transfer to the water there must be a time element and a temperature differential between rim and water, the magnitude of each depending upon the amount of energy being dissipated and the rate of flow of cooling water. Since the flywheel effect of the rotor is not appreciable, the rotor is turned in the opposite direction during the raising of the empty blocks. By continuously circulating water at only about 25 per cent of the maximum rate otherwise required, the heat stored in the rotor during the running in of a stand is dissipated during the time of the round trip without exceeding allowable operating temperatures.

The resistance at any speed is adjustable by regulation of the d.c. current used to excite the field coils. For maximum resistance only about 70 amp. or 7 kw. excitation is required and this is usually available from the rig's standby light plant. In the case of an a.c. current supply, a rectifier is used to convert the current to d.c. The manufacturer has considerable latitude of choice in selecting means of regulating the field coil current. The control system now used for either a.c. or d.c. supply is a four-contactor drum switch, as it is an easy matter to move through the various contacts to control the load at any desired speed.

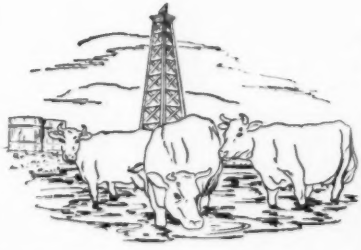
For any setting of the resistance control the horsepower capacity increases approximately in proportion to the 1.25 power of the speed; for example, if the speed is doubled, the horsepower resistance is increased $2\frac{1}{2}$ times. In starting from rest or while in operation, the resistance is immediately responsive to any change in speed and for any sudden appre-



COMPOUNDING DRILLING MUD IS A SCIENCE ALL ITS OWN

Through chemistry, modern drilling muds that throb through flow lines and play such a vital role in today's deep, high pressure oil wells have evolved into a complex, specialized science all their own.

As an example, the carefully compounded and controlled drilling muds used in deep Gulf Coast wells today are a far cry from the earth-and-water muds used in early discovery wells that established the Gulf Coast region as one of the world's most prolific, high pressure oil producing areas.



History records . . . and many an old-timer is still around to confirm it . . . that mud used in the Spindletop well was actually siphoned from a near-by mud hole, agitated by cows wallowing and tramping through the mire.

Drilling muds and chemicals have become an increasingly important part of the drilling operation. Drilling muds and chemicals to meet the multitude of problems encountered in today's deep, high pressure wells are developed in modern laboratories by skilled chemists. Each new chemical . . . each new refinement to drilling muds . . . is developed only after exhaustive research and tests.

Magcobar has met this challenge by providing the oil industry with a complete drilling mud and chemical service. This includes modern laboratories and skilled personnel for product development and quality control, and capable field engineers in laboratory-equipped cars with two-way radio to give prompt assistance at the rig.

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ciable change in the setting of the resistance control there is but a fraction of a second lag in the excitation of the field coils and corresponding change in resistance.

Fig. 3 illustrates the speed-horsepower characteristics of two approximately comparable sizes of electro (eddy current) dynamic and hydrodynamic energy dissipators when operated with the maximum setting of their respective resistance controls. These curves are also characteristic for each type with lower settings of their resistance controls.

Methods of Driving

The most common method of driving supplemental dissipators from the draw-works shaft is through a flexible coupling capable of compensating for any slight misalignment of assembly.

With the electrodynamic type of energy dissipator the manufacturer recommends that a plain flexible coupling be used and that the dissipator be allowed to rotate at all times.

With the hydrodynamic type of energy dissipator a combination flexible-cutoff coupling may be used to advantage, particularly with the larger sizes. By declutching when the braking action is not required, any inertia effects of the rotor are eliminated from other operations of the draw works and shaft seals and bearings are relieved of any unnecessary wear. The shaft drive assembly is also relieved of any reversal of stresses caused by inertia and the frequent changes in direction of rotation when running in or coming out of the hole.

An overrunning or free-wheeling type of clutch is of particular and further advantage for use with the hydrodynamic type of energy dissipator. This clutch automatically and positively engages the energy dissipator at the instant the draw-works drum starts rotating in the direction to run in a stand and the energy dissipator is not revolved when raising the blocks. It eliminates any possibility of the drive shaft and keys being subjected to shock loading caused by delayed clutch engagement at the start of running in a stand or, more seriously, by the clutch engagement after the drum has attained a high speed.

High Speed Supplemental Energy Dissipators

In recent years the use of small high-speed supplemental energy dissipators driven from the drum shaft through a chain speed increaser has become increasingly popular, the only practical limitations to their use being the safe maximum operating speed of the dissipator and the safe maximum operating speed and load capacity of the chain drive.

To date the most common installa-

tions of high-speed dissipators have been on draw works designed for operation to 6,000 ft. or less. They are also used on some draw works recommended for 7,500 to 8,000 ft. and have been adapted for one draw works recently introduced and recommended for 15,000-ft. drilling.

Advantages of high-speed energy-dissipator installations include compactness of assembly and more flexibility as to location on the draw works and the possibility of faster operations due to their having a considerably lower inertia factor and less drag for reverse direction of rotation. In the case of hydrodynamic energy dissipators the small high-speed types have the further advantages that they lend themselves to simpler circulating water arrangements, more flexible resistance regulation and quicker response. This is due to the fact that both high and low-speed dissipators require the same total water circulation to dissipate the same amount of energy but with the high speed dissipator the circulation is faster and the volume of water in the case at any time is less.

An obvious disadvantage is that the chain drive represents an additional element requiring some attention and eventual replacement. It is also true some types and designs of draw works lend themselves more readily and practically to the slower-speed and direct-driven dissipators.

Automatic Drilling Controls*

IT has long been recognized that the maintaining of constant loading on drilling bits will result in more footage per bit and more footage per unit of time, all other factors being equal. The result is fewer round trips with their horsepower-hours, wear and tear on rigs, etc.

The best of hand-feed brake levers is a poor substitute for full automatic control, since worn brakes creep off and either "drill off" or "pile on" weight. Most are worse than this in that they frequently drop off from one-fourth to one-half a drum revolution suddenly when worn. It is physically impossible for a man to feed constantly for long time periods, just as it would be on a lathe or other machine tool.

With automatic control, the driller can watch his drilling-rate chart and his other drilling symptoms and adjust his feed weight and rotating speeds to obtain the best possible results. By making constant one of his drilling variable, i.e., the weight on

*W. S. Crake, chief mechanical engineer, Shell Oil Co., Inc. Summarization of paper presented at meeting of Petroleum Mechanical Engineering Conference, A.S.M.E.

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the bit, the rotary speed automatically steadies down in any given formation and the table behavior becomes a very sensitive indicator of formation changes and types. The penetration-rate indicator, or recorder, in most cases gives a clear graphic story of a bit becoming dull and can save many additional hours "hoping the bit will make a few feet more."

Types of Control Systems for Drilling Rigs

(a) Weight control.—Since weight on the bit is probably the chief determinant of drilling speed under given conditions, it is obvious that practically all systems of control have considered this problem.

Regardless of whether the weight on the bit is the primary control, or is governed by other physical effects, such as torque or feed speed, the weight must be controlled, or limited, because bits are built to withstand only so much weight, and still perform satisfactorily.

We have seen from previous sections of this report that the hook-load signal is generally a sensitive and accurate means of determining bit load. It, therefore, becomes obvious that a weight controller can be used and made to hold such weights as the driller feels desirable for the formation being drilled up to the limits prescribed by the bit manufacturer.

Under normal circumstances, in fairly homogeneous formations, a simple weight controller will suffice. In nature, rocks of very considerable hardness difference and drillability are layered often in inches or less, and a bit is generally designed to drill quite wide groupings of materials at constant weight. A considerably better performance is obtainable by the driller varying his rotary speed and weight on bit to known values to suit his experience.

Weight control has the following features:

1. The surface signal is reliable and accurate and little affected by down-the-hole friction since the downward motion of the pipe is the "minor motion."

2. By providing suitable time delay for the instruments to operate against load changes, the load can be accurately controlled. It takes quite a considerable surface feed distance to make any material load change on the bit, due to the elasticity of the drill-pipe system.

3. The surface signal is extremely sensitive to bottom-hole weight changes under most conditions.

4. The penetration rate of the bit selects itself for the formation drilled. It is at the driller's control, secondarily, by changing the controlled weight, at his desire, to suit the formation.

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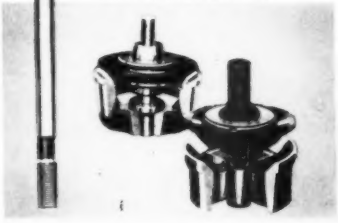

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TABLE 1—PICKUP OR PRIMARY SIGNAL DEVICES* FOR AUTOMATIC DRILLING CONTROLS

Type of signal—	Electrical	Pneumatic	Hydraulic
Weight, or load	Resistance strain gage. Magnetic strain gage. Dead line angular displacement against hydraulic or pneumatic device. Torque-measuring devices. Null balancing against main drum torque.	Dead line angular displacement—Thurstorq type. Torque arms with null balance against load.	Dead line angular displacement—Martin Decker type. Dead line full load on hydraulic cylinder. Torque arms and null balance against load.
Speed, or feed rate	Tachometer generator.	Small compressor discharge against variable orifice. Pressure across orifice is proportional to speed. Requires a speed indicator such as an electric tachometer to give true speed.	Pump discharge against variable orifice. Pressure across orifice is proportional to speed. Requires a speed indicator such as an electric tachometer to give true speed.

*All devices must be fully temperature compensated, or unaffected by temperature, over operating range.

TABLE 2—CONTROLLER TYPES FOR DRILLING CONTROLS

	Electrical	Pneumatic	Hydraulic
Weight	For use with electric brakes. Null balance control of armature current of brake motor. Null balance control of field current of eddy current brake. Electronic controls give highest speed of operation, great flexibility.	Pressure controller, using motor valve to operate brake. Signal from weight devices, Table 1. With floating proportional band adjustment. Fast and flexible operation.	Hydraulic pressure controller with brake operating motor. May employ signal from any source, Table 1. Faster but less flexible than pneumatic. Requires special damping.
Speed	With electric brakes. Control of field voltage of brake motor from tachometer generator signal. Control of eddy current brake field from tachometer generator signal. Superimposed on, or in series with, weight control.	Pressure controller as above, with motor valve to operate brake. Signal from hydraulic or pneumatic devices, Table 1.	Pressure controller similar to above, with motor valve to operate brake. Signal from any source, Table 1.

TABLE 3—TYPES OF BRAKES FOR AUTOMATIC DRILLING CONTROLS

Electrical	Pneumatic	Hydraulic	Mechanical
Motor balanced against torque load. Can be overexcited to raise load. Eddy current brake.	Air compressor operated against variable orifice. Air pressure on pistons holds load. Controller operates motor valve on discharge of compressor.	Oil pump operated against variable orifice to control pump pressure. Fluid pressure on pistons holds load. Controller operates valve on discharge of pump.	Precision friction brakes, preferably oil immersed. Brake applied by motor valve, hydraulically or pneumatically operated.
Balanced-torque-arm type with motor to drive feed gear train.	Balanced torque arm, with air motors to drive feed gear train.	Balanced torque arm, with fluid bleed to lower load—dual brakes used (Kinzbach). Hydraulic variable speed transmission using constant torque, variable stroke pump. Speed governs stroke. Weight governs pressure.	

(b) Speed control.—A simple speed control on ordinary drilling operations is, in the writer's opinion, an unsatisfactory single means of controlling the process. An ordinary hand or hydraulic brake which can be set sensitively, is a form of speed control. Unless formations are quite homogeneous, and this is a rare state of affairs in well drilling for more than a few feet at a time, a constant speed, slightly too fast, must "pile up weight" and, slightly too slow, must "drill off." As the speed-weight combination impressed by the controller cross the speed-penetration-ability curve of the bit in that particular formation, stability of weight and speed can be reached, but with no relation to the load capacity of the bit. By being too light or too heavy, waste of bit life occurs on one hand, or bit damage on the other hand.

On specialized operations, such as reaming, if formations are fairly uniform, speed control may be used to give good results, if down-the-hole stability is possible.

We have discussed the point that mean bottom-hole-weight variations are very close to surface-weight variations. Surface variations of feed rate, however, due to the incalculable effects of elasticity in the string, have little relationship to down-the-hole speeds of progress, except that they are both in a downward direction.

Speed control has the following features:

1. The speed can only be controlled at the kelly. Both signal and control is surface-done without relation to the drilling action.

2. The forward speed of the bit determines itself and has no relation to the speed at the surface except as interpreted by the driller on the weight indicator.

3. The weight on the bit has a value induced by the speed of feed and has no relationship to the bit manufacturers' recommendations, except as the driller changes the speed by hand.

(c) Torque.—A number of investigations and patents describe torque as a means of controlling drilling progress. This factor could be used as a control signal except for the fact that, firstly, torque changes take place when going from one formation to another and, secondarily, that a desirable drilling torque in one layer an inch thick may be too low for the next layer. This would require a torque increase. This can only be applied to the bit by lowering the drill pipe as fast as the torque change takes place. The next inch might require a reduction of torque and this would require lifting or stopping the pipe. This would be impractical and complicated, and it is believed better to let torque be self-determining within the reasonable strength capacity of the bit. The thought of torque as a control evidently stems from the old days when twistoffs were the bugbear of the driller. This is not the case nowadays and, when trouble is experienced in this direction, it is infrequently the fault of the bit. The drilling control cannot be expected to enable the user to forget fatigue, worn-out drill pipe, or occasional "boll weevil" stunts on the part of the crews.

If torque is used as any signal, it may be considered as a safety signal to disconnect the rotary in the event of too high values. This, or even a discussion of what excessive torque consists of for drill pipe, does not belong within the scope of this report, and it is the writer's opinion that any torque-control device is superfluous. A torque indicator, how-

ever, is a highly useful and desirable instrument for the driller's panel.

(d) Combination controls. — While the above discussion indicates that the weight control has by far the most desirable characteristics for general conditions, there are definitely occasions, such as occur when the bit suddenly penetrates a cavity, when the simple weight controller would "run away." Also, when drilling very hard formations and a soft sand or very porous formation is entered by the bit, the same thing might happen. If this would not cause runaway, it might crowd the bit into the soft formation faster than the cuttings should be removed and jam the bit or "ball it up." In such cases, a speed "governor" with variable speed-limit setting is highly desirable, in fact necessary, for safety's sake. For reaming or light-weight drilling it may also prove desirable, and it is very useful for starting up the controller, since the weight-indicator reading assumed to be the compensated self-balanced result of rotation, pump flow friction, etc., should be taken just before contacting bottom and with the bit being lowered at some controlled uniform speed close to the expected drilling speed.

Accordingly and from experience obtained in the field, it appears that the bit weight controller with variable-speed-limit control, also automatic, becomes the most useful controller type.

(e) Overwind and external power sources.—The braking device can be one of two distinct types. The first receives its rotative power from the wire line through the drum and the brake merely destroys this energy. This is the simple overwind type and requires no external horsepower to operate the controller, other than the small amount needed for instrument operation. This involves ¼ hp. at the most.

The second type is one in which the cable load is balanced against a torque produced by a device such as an electric motor. The balancing power comes from an outside source, or generator. While the first type is probably most desirable because of its ability to furnish its own power, the latter type can generally be made to give better sensitivity and speed of operation and can also furnish motion in the reverse direction to lift the load slowly and reset the weight on the bit without using the main engines or drum clutches.

In determining which of the two devices will eventually be most acceptable, field experience as to requirements, cost, reliability and simplicity, will eventually be the determining factors. The author feels that either type can be made sufficiently accurate and sensitive for the job and that cost, reliability, and simplicity will be the main requirements.

Safety Devices

As with any other device of important duty, involving possible high monetary losses or danger to human life in case of failure, certain safety devices must be included in any good controller for a drilling rig. Since an acceptable control operates with the main brake handle completely up, the reason for safety devices is clearly seen.

(a) Power failure.—In the event of failure of the power supply to the instruments or any part of the controller supporting load, a device must be installed to lock the controller brake or shaft. This would mean that, in case of spring-loaded brakes, the power must push the brakes "off" rather than "on."

The safety device must operate so that gradual leakage of, say, air from the system would apply the brake before the controller itself lost control of the load.

A new-voltage trip should also be included in electrical devices, which would not permit running unless proper voltage was available.

(b) Overspeed trip.—In case of the operator turning a setting knob in the wrong direction and causing excessive speed to occur, an overspeed trip should be included. This device should operate the brake similarly to the power failure device.

(c) Emergency stop.—A quick emergency stop should be available on the operator's panel, such as a valve or pushbutton, which will enable the operator to shut the brake off rapidly in case of emergency.

(d) "Twistoff" indication.—The weight controller has one useful characteristic in that, in the event of a twistoff, less weight would be suspended on the hook and, regardless of whether the driller was present, this would have the same effect as too much weight on the bit, would apply the brake, and stop the feed. No further feeding would be possible unless the driller caused it to be so. This would eliminate much damage to the fish and prevent the trouble sometimes caused by "drilling by" with a twisted-off string. If the twistoff was caused by a fairly heavy section being broken off, the released spring effect in the pipe would raise the rotating portion several inches or more clear of the fish.

Application Methods

(a) Transmission and connection to hoist.—The controller transmission may be directly tied to the drumshaft or may preferably use any portion of the existing hoist reductions possible. In order to reduce static friction, which is undesirable in "starting" the brake, roller, or ball bearings are most desirable throughout. The use of chains is quite satisfactory, although gears are more compact.

Since the load factor at the highest loadings for a given unit is very small—probably below 5 per cent—normal transmission "wear ratings" can be considerably exceeded if the case or mountings are mechanically strong enough to resist occasional sudden brake application without distortion.

In order to allow the driller to throw the main engines into action in an emergency, the clutch to the control transmission should be connected with a nonreversible clutch. All clutch faces, if of jaw type should be backcut since the whole string is suspended on these faces and any vibrational throwout would drop the pipe on bottom.

If a friction connecting clutch is used, this should be control-interlocked with the main engine drive clutch so that the control transmission will be thrown out of action automatically before the engines are applied to the drum. Control of the transmission clutch must be at the driller's position.

Design of the transmission and brake setup requires torque, speed, and horsepower consideration.

(b) Pickup or signaling devices.—All weight and speed-control devices should be unaffected by, or compensated for, temperature changes within the operating range.

Table 1 shows a number of methods of obtaining suitable signals proportional to weight and speed. These signals may require amplification to give sufficient power to operate controllers. Differential devices may be used to amplify only the variations above and below set points.

(c) Controllers.—Weight and speed controllers should be practically unaffected by temperature over the operating range. They should be simple to operate and adjust by nontechnical personnel. Table 2 illustrates some types of controllers available.

Mixed types of controllers and pickups are very practical, and the simplest and most reliable signaling device for the job can generally be adapted to operate almost any type of controller the designer wishes to use. The controller in turn can operate several types of brakes.

(d) Retarder or brake.—Table 3 gives a description of various types of brakes which can be used.

As pointed out previously, the transmission used is part of the energy-destroying system and static friction of this system should be as low as possible. A very slow rate of creep is highly desirable so that static transmission friction is destroyed. This

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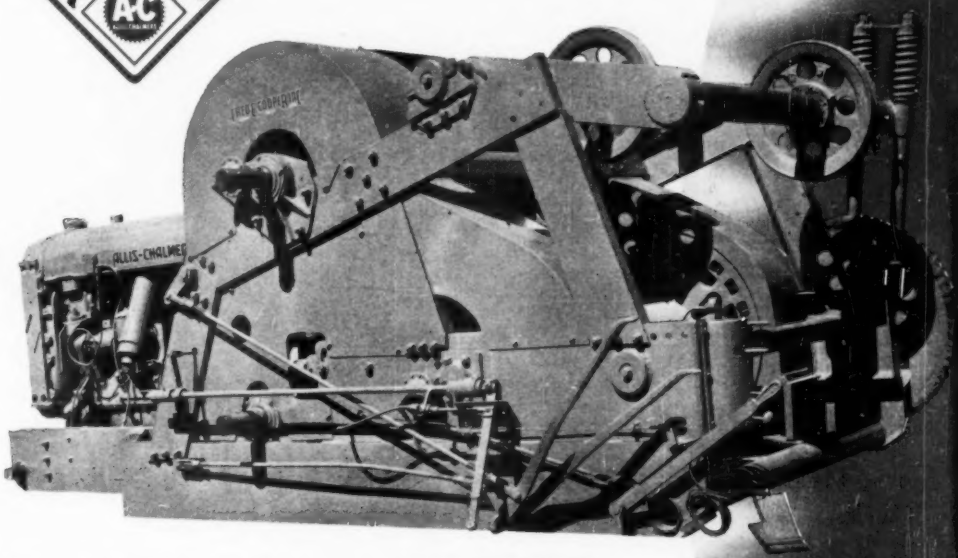

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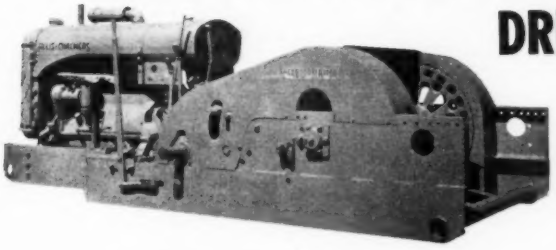

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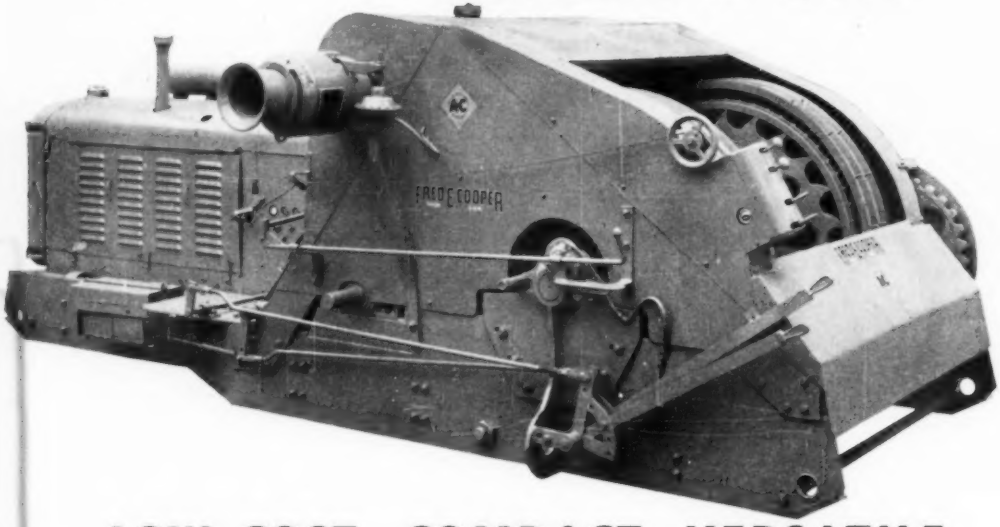

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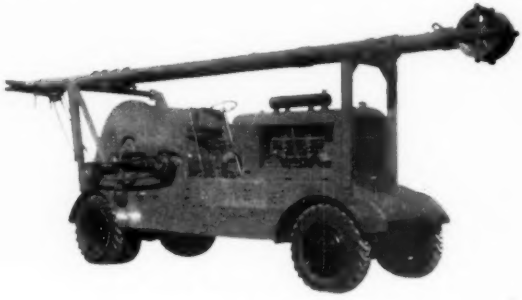

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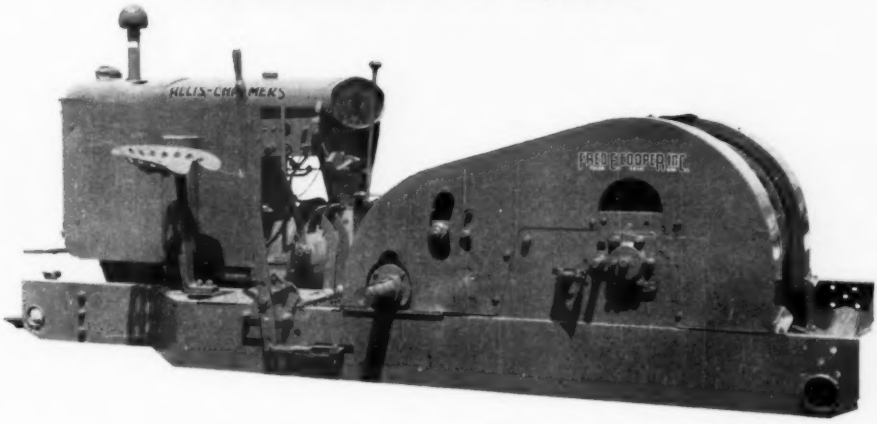

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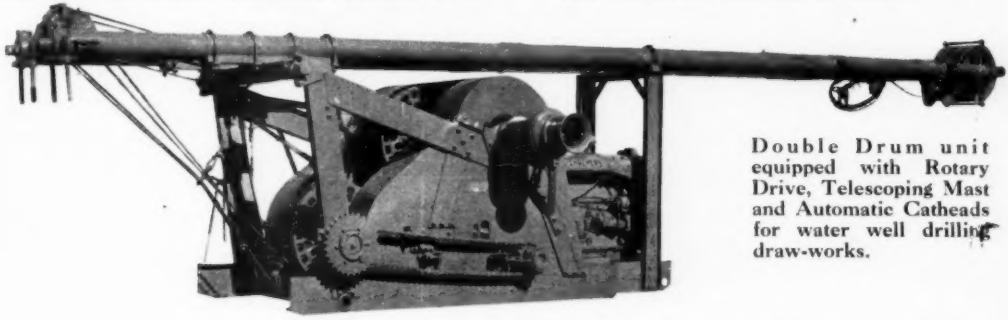

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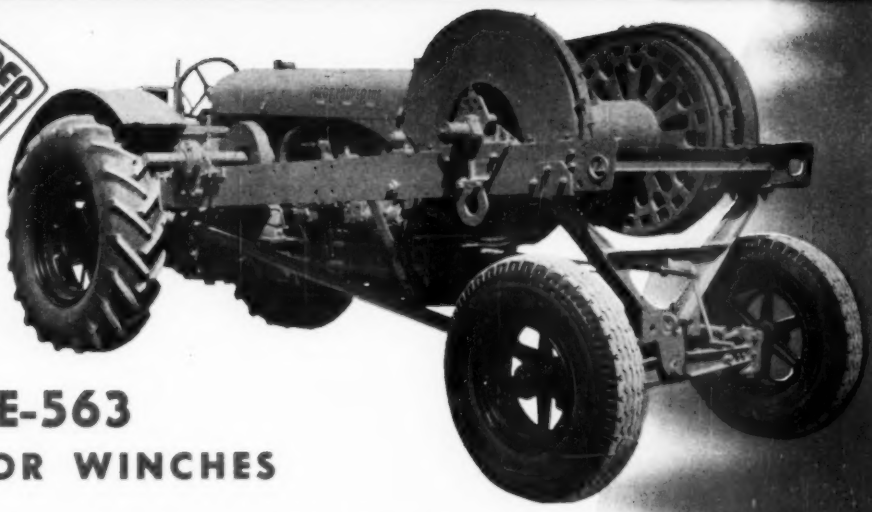

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rate, however, should not exceed the equivalent of about 1 in. per hour feed rate of the brake, in order that it cannot affect the slowest drilling rates as, for instance, in chart when 2 or 3 in. per hour is quite common.

Such brakes as the eddy-current type require a mechanically reversed rotating field to overcome the natural slip of the brake at low speeds. If hydraulic pumps are used with a slip rate greater than prescribed above, a makeup pump must be used to supply the slip fluid.

Any one of the forms of brake, except the electrical, which requires electrical control means, can be used with any type of suitable controller. The most suitable combination is one which uses the most reliable, rugged, simple and accurate device in each of the three main portions of the system.

(e) Instruments for the system.—In crder to enable the operator to control the system and locate troubles rapidly, certain minimum instrumentation is required. This is listed below.

1. Total-weight-indicator gage (existing standard gage may be used, if accurate). A weight-on-bit gage is desirable, reading 0-50,000 lb. A vernier scale is also desirable on the latter for accurate work, such as fishing.

2. A main power gage is necessary, such as voltmeter or pressure gage. This indicates value of voltage or pressure in the main power supply.

3. A rate-of-feed indicator showing feed rate in feet per hour.

4. Supply adjustment regulator and pressure gage for each main device used such as weight and speed controllers, or motor valves used for other vital services.

5. Gages on controllers to show controlled variable, or signal, of speed and weight and output to motor valve or brake.

An additional instrument which is desirable is a drilling-rate recorder. This should include a record, on the same chart, of either the weight on the bit, or the total weight on the hook. It should also include a chronograph pen device which will mark the chart each foot drilled and a switch on the driller's panel to allow the recorder to be started and stopped at the driller's will as the drill pipe is picked off or set on bottom.

The above chart then becomes a penetration-rate chart for use of the engineers, and the inclusion of the bit-weight record shows whether a change in penetration rate was natural or caused by the driller having changed the weight setting on the bit.

This device can be included as a separate attachment and should be movable separately so that it can be used, or not. The recorder may be needed away from the driller's position and, therefore, requires a connecting cable, say, 75 ft. long to give it flexibility of installation.

THE DRILLING STRING

Large Drill Pipe Speeds Drilling

DURING the past few years the need for greater circulation rates brought about by deeper drilling has been met to some extent by design of drill-pipe upset and tool joints to offer a minimum amount of restriction to the passage of drilling fluid. The improvement of design, however, as a means of increasing circulation rates appears to have been fully exploited, and to keep pace with the economic demand for faster drilling of deep wells with a minimum amount of trouble due to stuck pipe, Humble Oil & Refining Co. made an investigation of larger pipe.

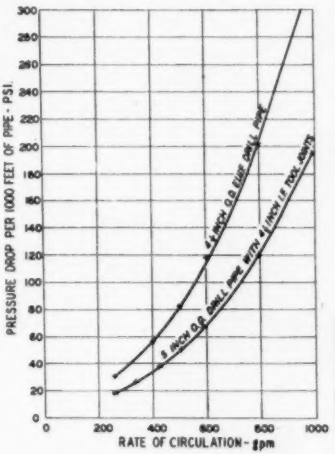
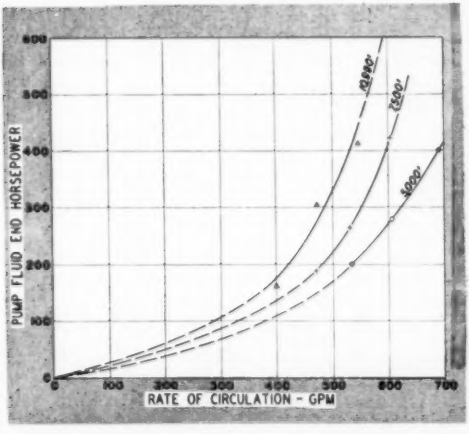

PRESSURE DROP PER 1000 FEET OF PIPE - PSI
RATE OF CIRCULATION - gpm
4 INCH O.D. EUE DRILL PIPE
3 INCH O.D. DRILL PIPE WITH 4 INCH I.F. TOOL JOINTS

Fig. 2—Pressure drop versus rate of circulation for two sizes of drill pipe

Fig. 1 is a curve showing relation between rate of circulation (g.p.m.) and pump hydraulic horsepower based on drilling operations of a Humble rig equipped with 4½-in. o.d. drill pipe fitted with internal flush tool joints. The tremendous increase in horsepower which would be required to maintain 600-g.p.m. rate of circulation is brought out in the curve.

At 5,000 ft. with a circulation rate of 600 g.p.m. the fluid end horsepower requirement amounts to 280. When the depth has approximately doubled, or reached 10,990 ft., the horsepower requirement advances to 625.



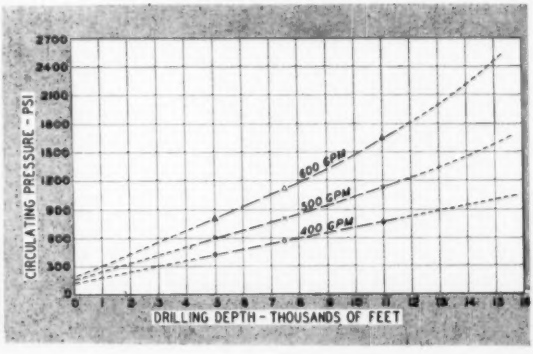


Fig. 1—(Left) Four-and-one-half-inch o.d. EUIF drill pipe. Fluid-end horsepower at three different depths using 10.3-lb. per gal. mud at a viscosity of 41 seconds A.P.I. Fig. 1A—(Below) Circulation rate requirements for different drilling depths

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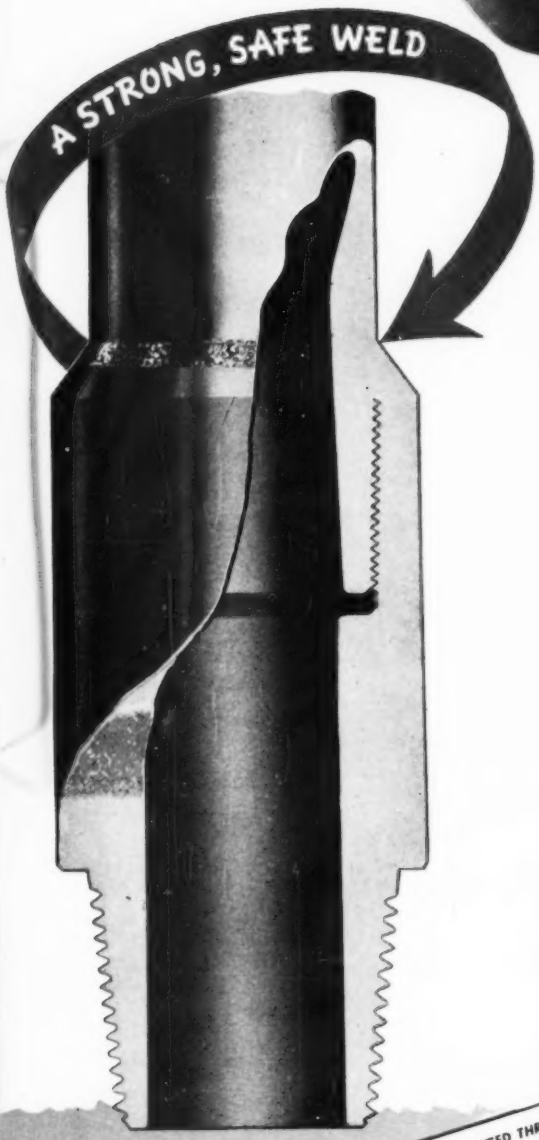

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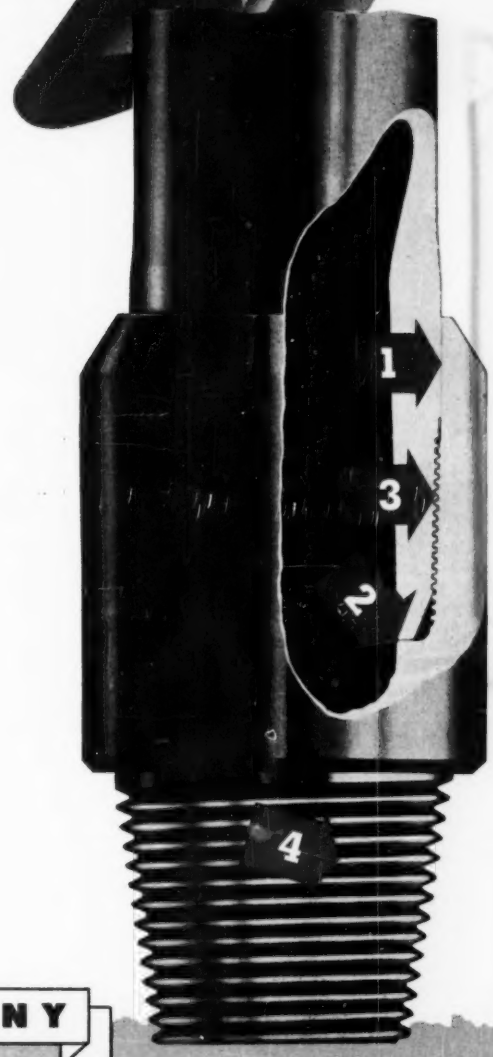

1 **The "Shrink Grip Safety Area"** supports the drill pipe against bending and failure at last engaged thread. Seals against leakage.

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With the same mud conditions as involved in Fig. 1, Fig. 1-A shows the circulating pressures required to maintain various rates of circulation at different drilling depths. Fig. 1 was based on a drilling condition involving 10.3-lb.-per-gallon mud with a viscosity of 41 seconds A.P.I.

Fig. 2 shows the pressure drop in pounds per square inch per 1,000 ft. of pipe at various rates of circulation for 5-in. o.d. drill pipe with 4½-in. internal flush tool joints, and 4½-in. E.U.I.F. drill pipe with I.F. tool joints. Arbitrarily selecting a circulation rate of 900 g.p.m. it will be found that the pressure drop amounts to 260 psi. per 1,000 ft. in the 4½-in. and only 160 psi. per 1,000 ft. for the 5-in. A 38 per cent reduction in drill-pipe pressure loss is effected through the use of the larger-size pipe. With the same pressure drop in both sizes, or 160 psi. per 1,000 ft., the increase in circulation rate of the 5-in. over the 4½-in. amounts to 200 g.p.m., or over 28 per cent.

Fig. 3 shows a comparison between

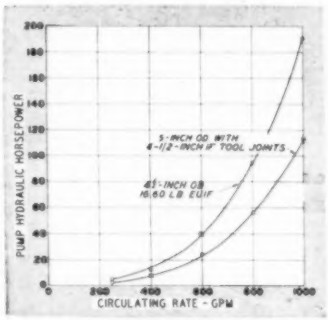


Fig. 3—Hydraulic horsepower versus circulation rate for two sizes of drill pipe

the hydraulic horsepower requirements for the two sizes of drill pipe. At a circulation rate of 900 g.p.m., the use of 5-in. o.d. pipe effects a reduction of hydraulic horsepower of 40 per cent over that required by 4½-in. pipe.

In going to the larger-sized drill pipe Humble did not find it necessary to alter its casing program in any way. The only adaptation necessitated through the use of larger drill pipe was with regard to elevators, pipe slips, and blowout preventers. The bottoms of the elevators were bored and rams in the blowout preventers changed to accommodate the 5-in. pipe. Also the inserts in the slips were changed. Changing over to the large-sized pipe added only about 10 per cent to the weight of a 14,000-ft. string of pipe. The additional weight imposed no change in trip time.

The larger drill pipe has brought out a number of advantages. Greater penetration rates have been recorded through the increased circulation possible with larger pipe and it is expected that stuck pipe will be greatly reduced. The 5-in. drill pipe offers 33 per cent more torsional strength than the 4½-in. and it is also expected that part of the wear usually absorbed by tool joints will be distributed over the drill pipe.

At no time during testing of the large-sized pipe was there any indication that the pipe tended to induce lost returns while circulating or caused any unusual swabbing action while pulling out of the hole.

Use of Drill Collars*

THE generally accepted theory of advantageous use of drill collars is as follows: Drill pipe in the thousands-of-feet lengths used in a well is extremely flexible. If the bit is attached directly to the bottom drill-pipe tool joint and the total weight of the string, or enough of it for satisfactory drilling, allowed to rest on the bottom of the hole, it would immediately buckle into a complicated spiral curve inside the hole. The load on the bit would vary in a complex manner as the pipe rotated, depending upon how the sides of the hole supported part of the load. This would prevent drilling a straight hole and would subject sections of the pipe to severe repeated bending action during rotation. This bending action, repeated with every turn of the pipe, results in a phenomenon known as "fatigue," just as a wire bent back and forth to break it.

A remedy for premature drill-pipe failures and crooked holes is to add more weight at or near the bit in the form of drill collars. This puts the necessary weight for good penetration at the bottom of the hole and permits the rotating drill pipe to be in tension. A straighter hole is drilled and bending of the drill pipe is reduced. Furthermore, since there is little sidewise motion and the pressure of any lateral contact is greatly reduced, wear on pipe and tool joints is lessened. When sufficient drill collars are used, the drill pipe transmits only the torque of the rotary table and acts vertically as a conductor string for the drilling mud.

To assure that the drill pipe is always in tension, good practice is to utilize 50 per cent more drill-collar weight than is to be carried on the bit and disregard the effect of mud buoyancies. Thus for 15,000 lb. on the bit, 22,500 lb. of drill collars would be used.

When technical progress made it feasible, the problem of drilling chert and other hard formations was solved by adding more weight on the bit in the form of drill collars. This advance was not practicable until rock-bit manufacturers designed new types of bits that could stand a load of 5,000 lb. per inch of bit diameter instead of the former 1,000-2,000 lb. per inch.

Rock bits are now available with harder teeth in an improved pattern and, with greater bearing strength, lessening the danger of fishing for lost bit cones. These bits may even drill more footage per bit in this severe service than older-type bits in softer formations.

There are five principal objections to long strings of multiple drill collars:

1. The tool-joint problem.—Inability to keep the collars together has always been recognized as the leading difficulty in long collar strings. For satisfactory results with long multiple-drill-collar-strings, it is absolutely necessary to use utmost care and vigilance in every detail of procedure in making, breaking, and inspecting the threaded connections. Long, heavy, rigid, drill-collar sections impose high stresses on joint connections, and neglect of caution can lead to frequent failures.

The most common drill-collar break starts at the pin end, usually near the last full thread at the shoulder, and a progressive fracture finally severs the pin. Less frequently a break starts in the last engaged thread in the box and by a similar action travels to the outside. Box failures of this type can sometimes be caught in the rotary table at the first appearance of the crack since the outside surface is polished during service.

Failure Correction

Included in the corrective measures which have been tried for these failures are numerous threaded connections differing from the standard A.P.I. tapered joint. These have had some success, but the care used when trying experimental strings may be the reason for the lack of trouble.

Drill-collar joint stresses caused by too high a speed of rotation can be minimized by reducing the rotational speed, also advantageous in improving the drilling characteristics of bits. The stresses are caused by the string of collars whipping at high speeds, causing flexing and consequent lateral stress in joints.

Another inadvisable practice is the use of a double box-and-pin connection—inadvisable because it is usually good practice to reshop both the boxes or pins in the event of failure, and because there are twice as many

*R. J. Stoup, development metallurgist, Spang-Chalfant division, National Supply Co.

joints to make and break with this type of arrangement.

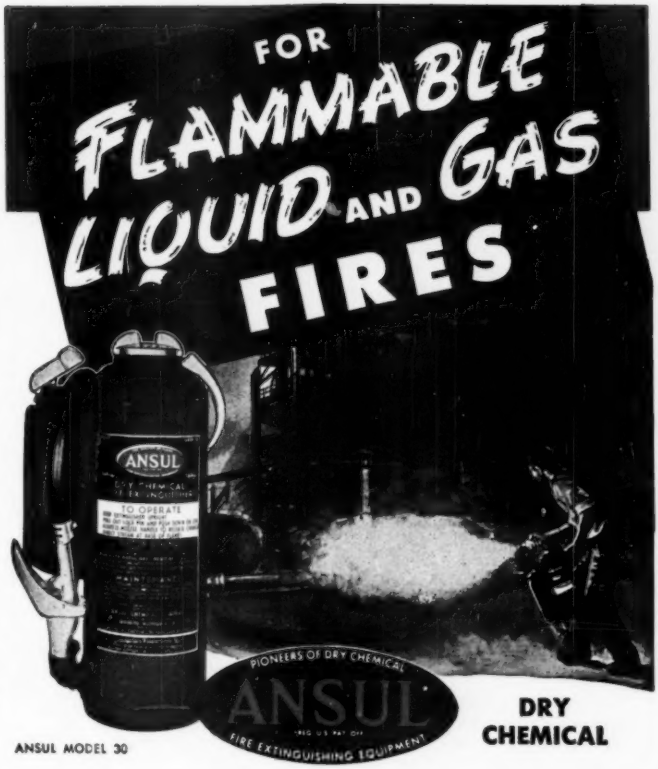
The problem with drill-collar connections can be solved to a large degree by maintaining elastic tightness at the shoulder. If the shoulder and reactive thread elements remain tight during drilling, there can be no movement and no wear or damage to the threads. The first essential in maintaining this contact is that the joints be set up tight enough and that they have the strength to maintain this tightness. Second, drill collars must be made with the axis of the threaded joint in line with the axis of the collar and the collar must be straight within close tolerances. Kinks or misalignment in drill collars impose a whipping action during rotation which puts high stresses on the joints. Such stresses may develop strains in the joints which will loosen the elastic shoulder contact and result in wobble motion with the attendant damage. With shoulder contact lost, rock bits aggravate the tendency to unscrew because of their free rotation.

2. Fishing difficulties.—It was once general practice to use small drill collars so that they could be recovered by washing over, and some companies now neck down the tops of the drill collars for this purpose. In recent years, the design of slips in overshots has been improved to the point where this tool is capable of taking a good grip on a smooth surface. However, it is still the practice among some tool pushers to specify collars with overshot grooves for easier fishing. This weakens the collar somewhat and may also start wedging in a crumbling hole, both of which are undesirable.

3. Handling difficulties.—Proper attention must be given to loading, supporting, and transporting drill collars in order to avoid excessive bending stresses in rough terrain, some operators using a pipe scabbard for this purpose.

4. Deviation from straightness. — Excessively heavy weight on the drill bit promotes deviation from straightness in drilling. Drillers have been able to minimize this trouble by frequent straight-hole measurements, and immediate corrective action such as reduction in collar weight and higher rotational speed. Reamers are also often used.

5. High initial cost. — Drill collars cost approximately 10 times more than equal lengths of drill pipe. It is believed to be false economy to run too few collars for reason of cost alone, because examination of drilling costs would show, barring extra fishing jobs which may accrue from more collars, real benefits.



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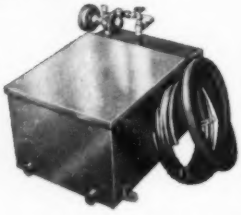

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The Drilling String

Drill-Pipe Protection*

CONSIDERABLE reduction in service failures in drill pipe from all causes may be attributed to better operating techniques developed by independent and group research of the contractors, mills, and independent research organizations. A brief discussion of each of these techniques follows:

1. Use of drill collars.—It is almost universal practice to employ long strings of collars to keep the pipe string in tension, lowering bending stresses in the pipe, eliminating column distortion caused by compression load, and adding greatly to the service life of the pipe.

2. Use of salt string.—A separate string of drill pipe, which has never been drilled in salt, is often used to complete hard rock drilling in freshwater muds. Usually, the string is picked up after the salt zone has been cased off, and the tanks flushed thoroughly and new fresh water mud is made up. An increasing number of contractors are adopting the procedure.

3. Reduced speed of rotation.—Operators have reduced speeds of rotation, particularly in the hard-rock areas, thereby reducing operating stresses to much safer levels with a resultant decrease in failure expectancy.

4. Use of smaller-diameter pipe.—There is a trend toward the use of smaller-diameter drill pipe as drilling depths increase, in some areas. Results of this practice have been good, the object of this technique being to provide a more flexible drill string to absorb increased loads.

5. Use of field inspection. — Increased use of improved field inspection services for the detection of fatigue cracks, corrosive pitting, and points of stress concentration which may lead to failure detects and thereby facilitates the removal of incipient breaks from the active drilling string. In this manner failures are prevented from occurring in the hole.

6. Use of protection methods.—The most successful protection methods thus far tried have been shot peening, use of chemical inhibitors, and use of plastic coastings.

Drill-Pipe Inspection

Several methods of drill-pipe inspection are available. Some of the most used of these are discussed in the following paragraphs.

Magnetic - particle method. — The magnetic-particle method of external inspection has been more greatly im-

*W. H. Crenshaw, American Inspection Service; V. B. Bottoms, Superior Oil Co.; C. N. Wallace, Western Plastic Co., Midland, Tex.; C. R. O'Dell, Tuboscope Co., Odessa, Tex.

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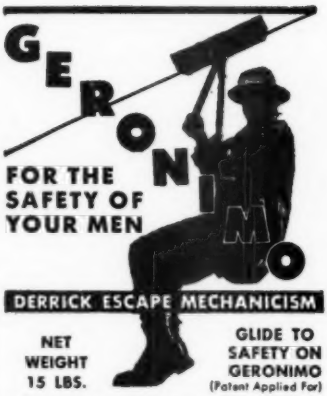

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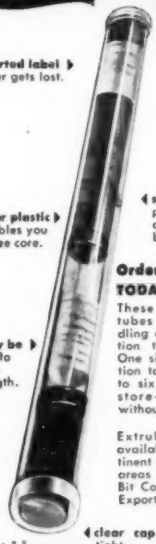

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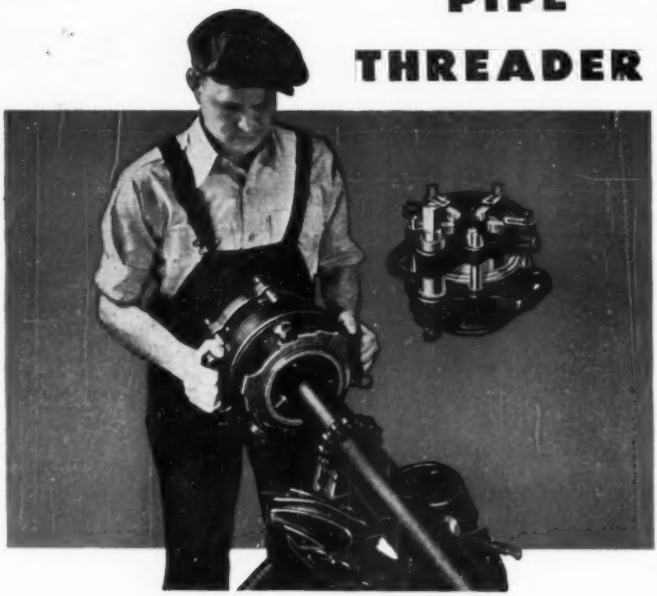

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proved than any other phase of the entire inspection operation. The method uses a controlled magnetic field, introduced into the pipe, usually in a longitudinal direction, by means of a coil carrying a low-voltage, high-amperage current. As the magnetic field flows along the pipe, transverse defects such as fatigue cracks, mill laps, seams, and inclusions offer a reluctance to its passage, resulting in some of the field pushing out into the external air at the defect. A north-side pole is set up on either side of the defect, creating the effect of a horseshoe magnet. A finely divided steel powder, especially selected for its magnetic characteristics, is applied to the surface area being inspected. When these particles come in contact with the external field set up by a defect, they are attracted thereto and align themselves in a pattern along the extent of the defect, clearly outlining it.

Internal inspection method.—Internal inspection of drill pipe is accomplished by means of an optical instrument for viewing the internal wall of the pipe, lighted by a mercury-vapor light mounted in the head of the instrument. The disadvantages of this method of inspection lie in operator fatigue, optical limitations of the instrument, and inability of the instrument to reveal to the operator minute and tight-lipped cracks.

A combination of the magnetic-particle method externally and better cleaning internally have led to better interpretation of the findings of the inspector, resulting in a lower margin of error, and lowered failure rate between inspections.

Inspection personnel.—The standard of inspection personnel improved with the return of many men from the armed services. The training of good drill-pipe inspectors is a slow and laborious process. To be a good safe inspector, one should have a basic understanding of metallurgy and of the stress conditions under which drill pipe operates. He should have a knowledge of fatigue and its effects on drill pipe; and he must thoroughly understand his processes of inspection.

Drill-Pipe Protection

Use of chemical inhibitors.—Chemical inhibitors have been used in the drilling fluid to reduce the effects of corrosion, and have been found to be helpful in some instances. Additional research and experience are considered necessary, however, before definite conclusions can be reached.

Use of shot-peened pipe.—A number of companies have employed drill strings which have been shot peened internally for the full length, and for 24 to 30 in. below the tool joint externally. The effect of the shot peening is to case harden the sur-

face of the pipe to a depth of 0.006 to 0.010 in., and to set up in this zone a compression stress. Inasmuch as any fatigue failure must occur from a tension stress, and a tension stress will not progress through a zone of compression stress, the possibility of failure from fatigue is greatly reduced.

Once the compression zone has been penetrated by corrosive pitting or mechanical damage, its effect is lost at that area. However, it has been noted that corrosive pitting is greatly retarded over a shot-peened surface. One string was observed which had been in service for several months in a highly corrosive area; 98 per cent of the peened pipe showed no corrosive pitting and 2 per cent showed a slight amount of pitting, while pipe in the same string which had not been peened was excessively pitted and much of it was rejected on inspection.

It may be desirable to protect the peened area with a plastic coating to further preserve its effectiveness from abrasive wear. One field test of this type showed that the coating would stay on for a considerable length of time. For this test only one finish coat was applied, with the idea of preventing the area from rusting while in storage. It seems reasonable to conclude that by following the regular coating procedure still better results may be had.

Use of plastic coating.—There are two types of plastics in use today as a protective coating—phenolic base and vinyl acetate base. The phenolic is sprayed on and air dried, sprayed on and baked, or dipped and baked. The vinyl is applied only by spray and is air dried.

Some of the physical properties of the phenolic thermosetting plastic are:

1. Oil resistant.
2. Chemically inert except to hot concentrated alkali.
3. Resistant to cold alkali in solutions of 0.3 normal.
4. Resistant to heat up to 400° F.
5. Abrasive resistant.
6. Chip resistant.
7. Has a hardness of 35 to 40 Brinell.
8. Has sufficient flexibility to bend on sheet metal round a 5-in. mandrel without cracking.

Some of the physical properties of the vinyl are:

1. Oil resistant.
2. Chemically inert except to concentrated nitric acid, glacial acetic acid, and carbon tetrachloride.
3. Abrasive resistant.
4. Is not affected by bending, flexing, contracting, or expanding.
5. Is not affected by temperatures from below freezing to 160° F.
6. Is not brittle and will withstand reasonable impact.
7. Has a stretch quality of from 180 per cent to 200 per cent.

Methods of coating. — At present, the most common method of cleaning is to blast the surface with an abrasive material. Sand is the most commonly used abrasive. Steel grit and crushed flint also are used. Acid etch is employed to clean used pipe before inspection and before blasting. Some operators feel that shot peening is of definite benefit to the drill pipe. This usually is done in connection with protective coating. After the surface has been cleaned, it is peened before the coating is applied.

Economics of Coating

Very few data are available on the field performance of plastic-coated drill pipe. In view of this fact, this discussion of economics is based entirely upon the results of the field test of one string, part of which was coated in the field—one of the most complete field tests of plastic-coated pipe to date.

This string was received f.o.b. Midland, Tex., at $3.13 per foot, without cleaning or coating. Using 4,266 ft. (141 joints) of uncoated pipe and 16,120 ft. of drilled hole as a basis, drilling with uncoated pipe cost 68.1 cents per foot for drill pipe. Assuming the life of a string of the coated pipe is 66 per cent gone after use in the test, depreciating it accordingly, and adding the actual cost of coating and recoating, plus the full value of junked pipe, it cost this operator 55.74 cents per foot for drill pipe to drill 63,868 ft. of hole using coated pipe.

Had the 63,868 ft. of hole been drilled with uncoated pipe, on the basis of the 141 uncoated joints used in the beginning of this string, it would have been necessary to buy 3.96 additional strings of pipe. Nine fishing jobs also would have been necessitated.

If the results obtained with this string can be regarded as typical, the use of plastic-coated drill pipe has proved to be practical both from an operating and economic standpoint.

Inspection Tool

A NEW testing device, the Sclerograph, operating on magnetic and ultrasonic principles, is designed for the testing of drill pipe, tubing, casing, and other tubular equipment. It will determine the tensile strength of tubular goods and also locate slag intrusions, laminations, and holes.

No cleaning of the pipe or core barrels is necessary prior to testing. The tubular goods to be inspected are hoisted off the ground by two hand-operated mechanical jacks in order that a coil of wire known as a "conditioner" may be passed over them.

After the pipe has been conditioned, a pickup unit is passed over the pipe at a constant rate of speed. This unit is tied into a recording device which is mounted in a panel truck. The graph thus obtained is used by the operators to determine the condition of the specimen being inspected. The entire operation consumes about 10 minutes for one joint of drill pipe and the apparatus required to perform the test can be set into operation in less than 20 minutes.

The operation of the Sclerograph is based fundamentally on the Barkhouser effect which was discovered in 1919. In brief this effect and the manner in which it has been used can be explained as follows:

If a conductor is wound into a coil and a current passed through the coil, a magnetic force is created which is proportional to the current

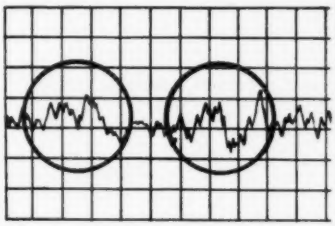

Fig. 1—Oscillogram showing a place of imminent fracture in drill pipe. A fracture was visible in this position after the pipe was used again

which it carries. If a specimen of ferromagnetic material is inserted in this coil, it will become magnetized by induction. The extent of the magnetization will depend upon the strength of the magnetic field and the magnetic permeability of the specimen.

This process of magnetization is not a spontaneous one, but according to Barkhouser's discovery, as the magnetizing force increases, the elementary magnets in the material align themselves in groups. These groups form larger groups, and so on through the total length of the structure. The length of each group varies with the density of the structure; therefore, through the measurement of the group it is possible to obtain information concerning the physical properties of the material under consideration.

The instrument is used to measure the intensity and length of these magnetic groups. Fractures, laps, seams, slag intrusions, or any other flow which would represent metal parting, cause the magnetic groups to become broken, and this will be indicated on the graph. The instrument also detects variation in structure due to changes in the density of the material.

DRILLING MUDS

Mud Control*

PROTECTION of permeability in reservoir zones may be related to the chemical composition of a mud and may be a factor in initial production rates. This thought has led to the use of extremely low-filtrate fresh-water muds, oil-base muds, and oil-emulsion muds for well completions. Use of limed or salt - water muds, or muds so treated that the filtrate would duplicate the chemical composition of formation interstitial water, are being tried.

Abrasive and corrosive action of drilling fluids are of sufficient importance to be controlled. Gel-strength reduction through chemical treatment permits the dropping of abrasive sand cuttings in surface settling ditches and tanks. Sodium chromate and sodium nitrate are being used for retarding the corrosive effect of some drilling muds on drill pipe. A maintained concentration of 2,000 p.p.m. of either of these salts in the drilling mud has been found adequate to arrest any observable corrosion.

Interpretation of electric - logging data is influenced by the effect of the chemicals in the mud upon the resistivity of the mud. It is most advantageous for sake of correlative interpretation of electric-log data for mud resistivity to be within a suitable range.

*Victor Horner, W. B. Kimbrell, Baroid Sales Division.

Weight control. — In preparing a weighted mud, barium sulfate, with a specific gravity of 4.3, is added to a prepared base mud, or to a base mud already in use in the drilling operation, and usually containing low-specific-gravity suspending material. As the weighting material is added for increased fluid density, the total effective volume percentage of solids increases. Dependent upon the effective per cent volume of low-specific-gravity material originally in the base mud, the amount of barite addition is, therefore, limited by resultant viscosity and gel strength.

As weight requirements for a specific mud increase, the effective volume percentage of low-specific-gravity suspending material must be reduced. This may be done (1) by dilution and addition of barite; (2) by dehydrating the low-specific-gravity particles, or (3) by employing a higher - specific - gravity solution phase.

Much-higher-weight muds may be prepared and controlled through the latter two design methods. The high-weight muds in use today, i.e., mud in the range of 15 to 19 lb. per gallon, are mostly of these types.

Control of highly weighted muds generally involves the matter of circulation loss where the mud weight must be controlled between the maximum permitted breakdown weight and the minimum required to overcome the formation pressures at hand. This condition generally places the weight at a fixed value with very little control tolerance. An understanding of the viscosity-weight relationship of weighted muds is particularly important in the design and control of such critical cases.

Viscosity and ge.ation control.— Proper transportation of cuttings depends on the "carrying power" of the drilling mud to lift bit cuttings to the surface and yet allow the finer cuttings, not removed by the shale shaker, to settle in the surface pits. Viscosity and gelation control are related to the mechanical drilling operations where annular velocity, drilling rate, and mechanical hole erosion must be considered. Because of its great ability to swell in water, bentonite has been the most widely used viscosity builder where viscosity is required in the design or control of a fresh-water drilling mud. Other special clays have been developed and are in use for providing viscosity and gel strength in saline solutions.

Generally, improvement of flow characteristics through reduction of viscosity and gel strength in fresh-water bentonite muds commands greater attention than increasing these values. Increases in viscosity and gel strengths due to hydration of clays from bit cuttings and hole erosion caused by drill-pipe movement are common problems. Use of water, tanstuff, and the polyphosphates to reduce viscosity and strengths are control methods in common use.

Filtration control.—Development of control over the filtration properties has depended upon the application of knowledge on colloidal suspensions. To minimize the filtration rate of a drilling mud requires consideration

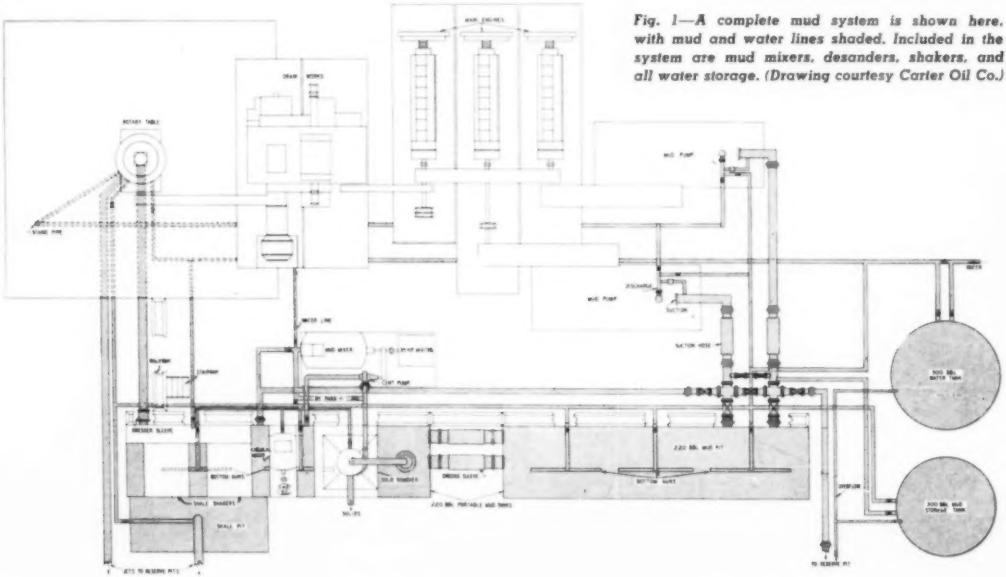

Fig. 1—A complete mud system is shown here, with mud and water lines shaded. Included in the system are mud mixers, desanders, shakers, and all water storage. (Drawing courtesy Carter Oil Co.)

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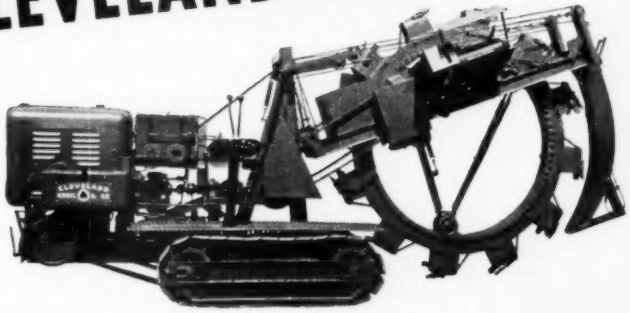

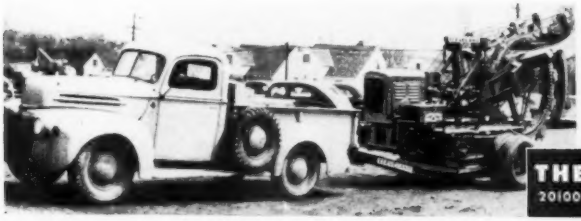

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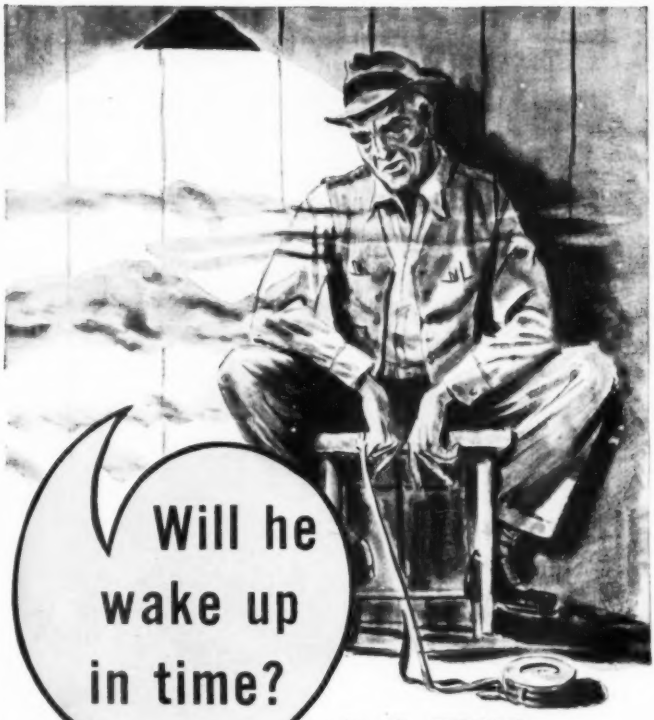

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as to the type of colloidal particle-size distribution, the degree of dispersion, and the concentration of the colloid used. Common sources of colloidal particles are from clays, bentonites, starch, and other organic colloids.

One method of control involves the use of chemical mud thinners such as some of the tannin compounds and complex phosphates. They have been very effective in reducing the viscosity and gel strengths of muds to permit much higher concentration of colloidal particles for a given viscosity, and in controlling flow characteristics and filter loss in fresh water-bentonite type muds.

Chemical controls. — Colloidal particles supplied by bentonite and other clays are chemically active, and their behavior is influenced by chemical contamination. Chemical control of contaminants affecting viscosity, gel strength, and filter-loss characteristics will minimize the flocculating forces and render the mud more fluid with a given concentration of colloidal particles.

Control of such contamination can be effected by the use of sodium bicarbonate in the case of cement by the use of sodium carbonate, or barium carbonate for anhydrite. Use of soda ash is limited by the concentration of sodium sulfate formed by the reaction, which can, in high concentrations, prove detrimental to most muds. Heavy anhydrite contamination is very effectively treated with barium carbonate, which removes calcium sulfate in its entirety.

The components which we find in all drilling fluids are the colloidal solids, semicolloidal solids, low-density solids, and in weighted muds, finely divided barites. Most of the actual work on drilling mud involves the addition of chemicals, the purpose of which is to control the behavior of the above-mentioned solids so that the resulting mud will perform the functions needed.

Types of Mud*

In recent years it has been found that ordinary slack lime may be added to high-pH red muds in order to give a mud that is very resistant to contamination. Most colloidal bentonites and semicolloidal clays are thought to be of sodium base, and calcium-base clays being much less viscous. By combining lime with the caustic-quebracho treatment it appears that sodium clays are converted to calcium-base clays which are less colloidal and therefore give less viscosity.

Normally calcium solids such as lime are thought of as being flocculents which give a thickening effect. However, when added to a mud containing a large concentration of caustic and quebracho, the lime converts the clays to calcium base and gives a mud that does not tend to pick up solids from the formations when drilled. The lime red muds have proved extremely valuable for drilling colloidal shales such as encountered in the Gulf Coast and particularly when it is necessary to carry high mud weights.

Lime red muds.—These muds can tolerate extremely high salt concentrations without losing control, and are extremely helpful when combating high-pressure salt-water flows. The muds are formed by adding about 3 lb. per barrel of quebracho, caustic, and lime. The proportion of these three ingredients may be varied, however. This type of mud is more stable and does not tend to disintegrate the formation drilled as readily as some other types of mud, possibly resulting in the cuttings balling up on the drill collars or sides of the hole. Therefore, the pipe should be worked at regular intervals to prevent accumulation of the balled cuttings.

Salt section muds.—Starch and other gelatinous organic colloids have been used to control the water loss of muds under conditions which normally flocculate colloidal clays. Very satisfactory salt-water muds can now be made using salt-water clays and drilling-mud starch. The starch may also be added to other muds when it is desired to lower the water loss.

When used, the starch must be protected against fermentation, this being accomplished by having the mud saturated with salt, carrying a pH above 12 or by the addition of preservatives such as formaldehyde, or sodium pentachlorophenate. It is most common to use starch in a high-pH mud, or if salt formation is to be drilled to use it in a saturated salt-water mud.

C.M.C. mud.—Carboxymethyl cellulose has recently come into use as a mud additive for controlling water loss. Its use is similar to that of starch; however, it does not need to be protected against fermentation which has made it a very valuable tool in certain types of mud. C.M.C. sells for considerably more than starch, but it usually takes much smaller quantities. It is sometimes cheaper to use C.M.C. than starch because of the expense of maintaining high pH values or other means of protecting against fermentation.

Oil and oil-base muds.—In certain formations it is possible to drill and complete very good wells with these muds, which if drilled with water-base fluids would produce little or no oil. Oil muds prevent the wetting of shales and other formations drilled and they prevent water blocking or sealing off oil-producing zones. Straight oil mud is essentially a mixture of a high-flash diesel oil, oxidized asphalt, and a soap formed in the mixture. The asphalt imparts sealing properties and the soap imparts viscosity and gel-strength control.

Emulsion muds.—These muds seem to give results that approach that attained with straight oil muds in some cases. They are not expensive and they have the appearance and behavior of an ordinary water mud. In some areas emulsion muds have eliminated such problems as sloughing shale and tight hole, and have speeded drilling in some cases. They may be an increasingly useful tool in the future because their lubricating properties increase the life of bits, making fewer trips necessary, reduce circulating pressure as much as 25 per cent, and reduce rotating torque considerably. Oil-emulsion mud is essentially a good water-base mud to which has been added approximately 20 per cent by volume of a high-flash diesel oil containing an emulsifying and stabilizing agent. Control is similar to that of ordinary muds.

Silicate plugs.—Work with what is called a silicate plug has obtained interesting results. The plug consists of mixing a high-ratio silicate of soda and a thick fresh-water mud made from clays and treated with deflocculating agents so as to obtain a pumpable viscosity with a high solids content. The silicate and the slurry are mixed in place, and result in a rubbery gel which serves as the plugging agent. Proper use of slugs of the silicate and mud will mix the two at the point of loss, simultaneously squeezing them into the formation. A thick clay mud may also be thickened in a manner similar to that above by mixing with a high-pH red mud.

Aside from the silicate-plug method which is suitable for rather extreme cases of lost returns, improvements have been made in the addition to mud of fibrous and flake materials, which depends on the large solids being strained out and building a mat on which the drilling mud will build an impervious cake. It is usual that 100 to 150 bbl. of such mud be mixed and pumped into the hole in order to plug off the point of loss.

Silicate-brine mud.—Experience indicates that by using a mud of this type, cuttings from disintegrating shales will be carried to the surface whole, just as they were cut from the formation. By using this kind of mud, and by carrying adequate weight, heaving shales can be drilled without difficulty.

*J. P. Weichert, Gulf Oil Corp.

CUTTING AND FISHING*

Inside and Outside Cutting

IT is an accepted axiom of drilling practice that *exactly* the same thing never happens twice on cutting and fishing jobs. In the most proper and undeviating sense, this is true; however, broadly speaking, at least 90 per cent of the cutting and fishing jobs may be so repetitive as to fall within standard or common procedure.

For instance, in freeing stuck drill pipe by means of cutters, the same tools are used but variations are applicable where difficulties are encountered. Should the pipe be severed at the location of a washout in the gage of the hole, an underreamer or a knuckle joint may be required before the tool is able to locate the top of the fish in the enlarged diameter of the bore. These additional tools would not have ordinarily been necessary if the fish had been cut where the hole bore was true to gage.

Special mills, each of a different shape, may be required to perform the cleanup operations on the same type of fish located in different restrictions within the earth. In cutting and fishing for liners, the procedure and the tools are both standard in every case. So, while each and every cutting or fishing job has its own individuality, the general classifications are just as standard as Chinese or English or Spanish or Americans.

It is hoped herein to classify the most common and prevalent types of emergency operations in drilling or rehabilitation and describe the techniques and the tools used in performing the surgery thereon.

Freeing Stuck Drill Pipe or Drill Collars

Procedure.—At the present time there are three accepted practices employed in cleaning a well bore of stuck drill pipe or drill collars. The first of these is the method of inside and outside cutting; the second constitutes an explosive and reverse torque; the third method involves a tool that unscrews the pipe.

The procedure of the first method requires a determination of the sticking point; secondly, the inside cutter is run on small-diameter drill pipe to a desired depth of severance above this sticking point; thirdly, fish thus freed is withdrawn and rerun with washover casing and a rotary shoe below; fourth, the rotary shoe is replaced with the outside cutter and the remaining fish is removed in sections.

*Frank Briggs, consulting petroleum-mechanical engineer, Houston.

Fig. 1—ANYTHING CAN HAPPEN ON A FISHING JOB—This pipe failure dropped, telescoped within itself, and was brought to the surface after successful fishing operations

The second method, commonly known as string or "bump" shooting, requires, first, the determination of the sticking point; second, the running in and detonation of the explosive charge; third, the washing-over and outside cutting of the remaining fish. The method of unscrewing pipe employs the reversing tool in combination with such grappling devices as taper tap, spear, or overshot. This method may be used as long as the tool is not required to operate below the casing seat.

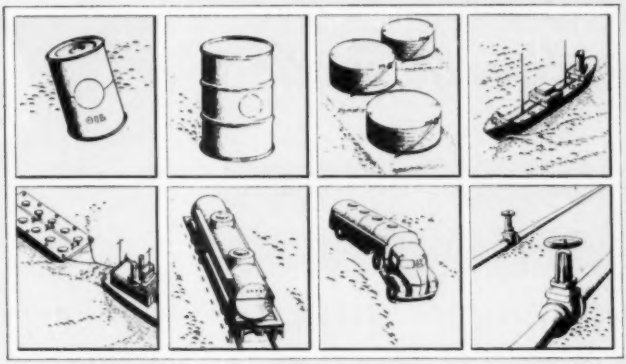
Sticking-point locator.—Selecting the tools in the order in which they are run, the first device would be the locator of the sticking point of the fish. At the present time there is only one such device in commercial service and this is an electromagnetic tool that consists of two magnets connected by a telescopic joint in which is combined a sensitive electronic indicator. This tool is run inside the stuck drill pipe on an insulated cable and when an electric current is conducted from the surface to the magnets they attach themselves to the walls of the pipe.

Any movement or elongation of the drill pipe under stress is then indicated by the separation of the magnets; it is detected and transmitted electronically to the surface. When no movement or elongation is evident the tool is released and set at successively higher intervals until an indication of stretch is obtained. Once this point is reached, successive trial-and-error settings accurately locate the sticking-point depth.

Inside cutter.—There are numerous designs of inside cutting tools that sever the pipe on the internal diameter; all embody these principal parts: friction blocks that contact with the walls of the pipe, slips that expand upon a mandrel and anchor the tool to the walls of the pipe, and knives operative under the influence of wedge surfaces. A typical tool is shown in Fig. 2. Run on the bottom of the small drill pipe, the tool is released by right-hand rotation. Due to the friction blocks (1) resisting this rotation, sleeve (2) is unscrewed from the nose piece (3) at the threaded joint (4). After this release, the tool is lowered slightly and the slips (5) expand on the taper mandrel (6) and anchor themselves into the walls of the fish. As rotation proceeds in a right-hand direction, the operating string is slowly lowered. This lowering causes the wedge arms (7) to con-

Fig. 2—THE INSIDE CUTTER—Ranging in sizes that sever 2-in. tubing to those that are capable of cutting 10¾-in. casing, this is an intricate mechanism that contains approximately 40 parts. The tool is capable of reuse without withdrawing from the hole. The numbered parts are discussed in text

Which fits into



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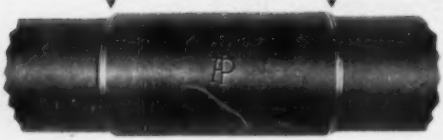

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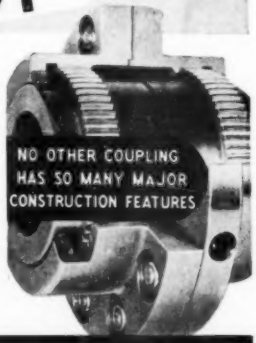

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New Brunswick, New Jersey
COUPLINGS

tact with the under side of the knives (8), forcing them to expand and gradually sever the fish. The slip and friction block section is permitted to remain stationary while the knife portion rotates; this is accomplished through the bearing (9).

The success of this tool is dependent upon the design and the material of its critical parts. For instance, the knives are of tool-steel material that has been subjected to an intricate heat treatment that provides a tapering hardness of 60 Rockwell "C" at the cutting point to a ductile hardness of 20 Rockwell "C" at the pin hole in the opposite end. The slips are hardened by carburization on the wicker side only; electrolitic deposition of copper retains the ductile properties of this member at critical points during heat treatment.

Drill pipe for cutting.—In some respects, the operating drill pipe that imparts motion and force to the inside cutter, although extremely simple, requires more metallurgy, more care in the fabrication thereof than the intricate and complex tools with which it works. This is so because it usually operates at the extreme limit of its tensile, torque, and endurance strength. There are two common sizes of this small pipe: 1.66 o.d. with 1 13/16-in. o.d. tool joints (for use inside of pipe from 2-in. tubing) and larger 2 3/8-in. o.d. with 2 1/2-in. tool joints (principally used in 4 1/2-in. drill pipe).

Originally the tool joints were connected by threading, bucking on, and bead welding. The present method employs either flash welding or a combination of gas welding and pressure. Either of these two methods provides a fusion of the metals of the members creating a joint that is stronger than the pipe itself. Fatigue failures at this point that were prevalent in the old threaded connections are extremely rare.

The application of tool joints to drill pipe by pressure welding is a development perfected during the wartime welding of aircraft members. A special machine equipped with hydraulic chucks for holding the drill pipe, a hydraulic ram for applying pressure at the welding surface, and an oxyacetylene torch has been constructed with automatic switches that eliminates the human elements of welding. Once the desired pressure, amount of gas, and upset at the weld has been set into the machine, these factors may be duplicated identically for succeeding welds.

Previous to the welding operation, both the pipe and the tool-joint ends are ground and mate very closely; a close tolerance at this interface is essential to exclude oxide stringers that would make a faulty weld. A succeeding operation is that of normalizing the welded section; this reduces the grain growth of the steel brought about by the rapid application of the extreme heat of the welding torch. The resulting product is a fine-grained structure with a hardness range that is not of damaging variance.

Power swivel.—The power swivel was designed to eliminate the hazardous, uncertain method of using a backup post in the rotary table and chain tongs attached to the operating pipe to provide the rotational force for cutting. There are several power swivels (and several power tongs, which may be used for the same purpose) available to the industry.

One particular type of power swivel (Fig. 3) embodies as a unit: a skid or

Fig. 3—THE POWER SWIVEL—An integrated unit, either skid or trailer mounted. It has a power source for driving a rotary pump; this pump in turn supplies the motivating force for a fluid motor that drives the swivel. The swivel unit is capable of approximately 2,650 ft.-lb. of torque while operating at a speed of 20 r.p.m. Hydraulic hose connects the pump with the controls, controls with the swivel

trailer that contains the prime mover (a gas-gasoline engine), the hydraulic pump, a pressure relief valve and a reservoir for the power fluid; the control mechanism, which is a four-way hydraulic valve mounted in a detachable case; and the power-actuated swivel that hangs from tubing elevators in the derrick. Each of the above is interconnected by hydraulic pressure hose. In this particular case, the prime mover is an engine which develops 20 hp. at 1,200 r.p.m. or 25 hp. at 1,600 r.p.m. This drives, through a self-aligning coupling, a hydraulic pump which at 1,200 r.p.m. transmits 14.9 hp. at 1,000 psi. with a volume of 20.8 g.p.m. A relief valve is set to trip at any desirable pressure up to 1,000 psi. and is generally operated at 800 psi. The hydraulic fluid is a clean oil having a viscosity range of 150 to 225 S.S.U. at 100° F.

The control valve is mounted in a detachable metal case, together with a pressure gage and a bypass needle valve. In operation, this case is placed on the derrick floor while the trailer and engine remain on the ground adjacent to the derrick. Connection between each is made with desirable lengths of hydraulic hose.

The swivel itself is designed to operate while hanging from tubing elevators. Backup arms are provided to resist the operating torque. Rotation is imparted to the swivel by means of a constant displacement fluid motor attached thereto. This motor develops a rated torque of 2,650 ft.-lb. while operating under 1,000 psi. and at 1,250 r.p.m. A cone-drive system of worm gearing (70 to 1 ratio) permits swivel speeds from 1 to 20 r.p.m. Right or left-hand rotation is obtained by means of the four-way control valve.

In operation, the swivel is attached to the small drill pipe after the desired cutting depth has been reached. The backup arms are usually tied to opposing girts of the derrick. The desired operating speed is obtained by

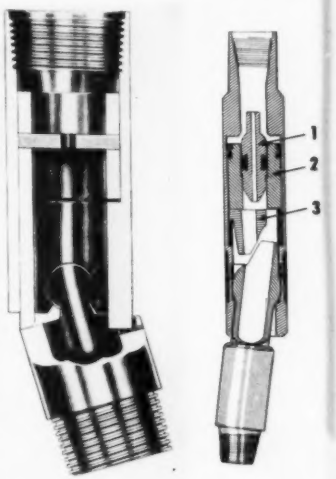


Fig. 4A—(Left) KNUCKLE JOINT—An example of one type of washover knuckle joint. Pressure from the mud system is exerted against a disk that partially restricts the inside diameter of the tool. This is exerted against a slidable sleeve with an extension on one side. This extension causes the lower section to bend or "knuckle." The guide, attached to the lower section, directs the fish into the interior of the tool. The fish passes through upon breaking the frangible disk

Fig. 4B—(Right) PLUG-OPERATED KNUCKLE JOINT—Knuckling action of this joint is caused by pressure on a plug which is dropped into the drill pipe after the tool has reached the fishing point. A restricted opening in the plug (1) causes a pressure increase, driving a control piston (2) downward upon the control lever (3), causing the knuckling action. The restriction plug is retrievable by an overshot on small drill pipe or wire line

means of the needle-valve bypass. The amount of resisting torque encountered by the cutter is sensitively recorded on the pressure gage within the control box; thus the progress and the completion of the cut are indicated to the operator.

Recovery Operations

Washing over.—After the first inside cut has been made and the free drill pipe withdrawn from the hole, the remainder of the fish is removed through alternate "washover" proceedings and outside cutting operations. This removes the remaining fish in sections, and these sections

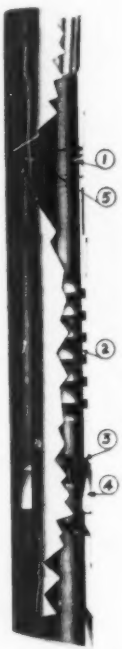


Fig. 5—OUTSIDE CUTTER—The dogs in the overshot of the tool bind, with an upward motion, under the tool joint of the fish. Thus a force is exerted through a pusher sleeve to the main spring which in turn forces the wedge rings against the knives. The knives bite into the outside diameter of the fish. Numbered items discussed in the text

will vary in length according to the risk or other conditions of the job. Assuming that the operator decides that 300-ft. lengths can be safely removed, approximately 330 ft. of washover pipe will be picked up and run above a rotary shoe and below the drill pipe removed (by the preceding operation) from the hole. A safety joint is usually placed between the drill pipe and the washover string; this tool permits release, by left-hand rotation, of the drill pipe from the wash pipe should the latter become wedged or stuck while in operation.

Assume, for the sake of employment of all the fishing tools available, that the rotary shoe fails to go over the top of the fish. This may be due to a large cavity in the gage of the bore at this point; the fish leans to one side. The string is withdrawn and a knuckle joint and overshot replace the wash pipe and rotary shoe. The knuckle joint (Fig. 4), operated by hydraulic pressure, has a piston arrangement that causes the tool to bend. This bending permits the overshot, upon rotation of the operating pipe, to sweep the cavity in an arc and contact with the fish.

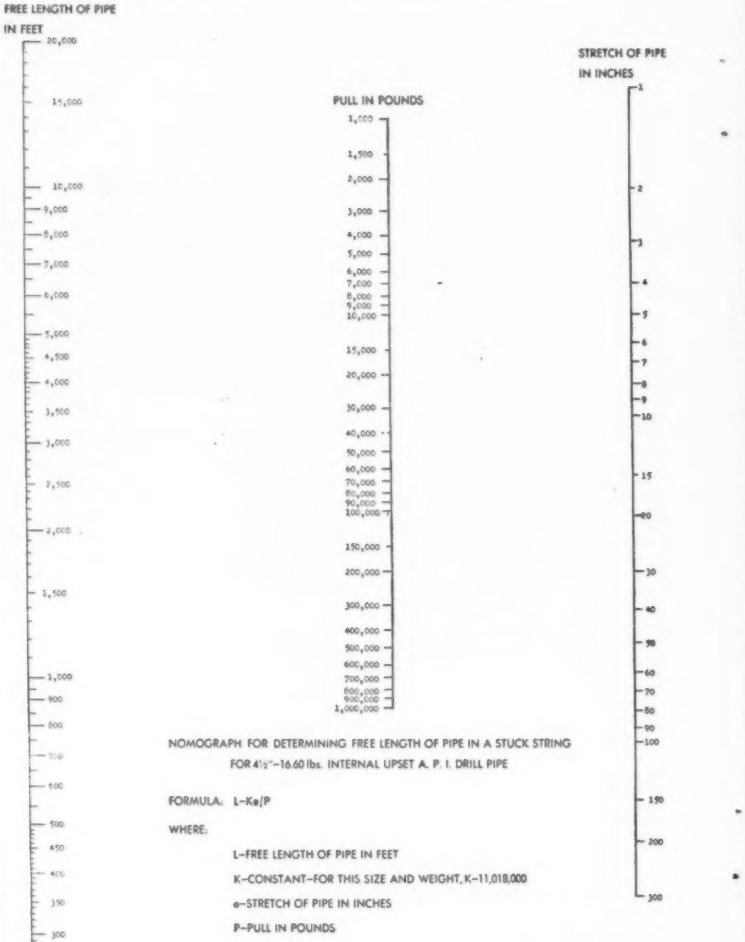
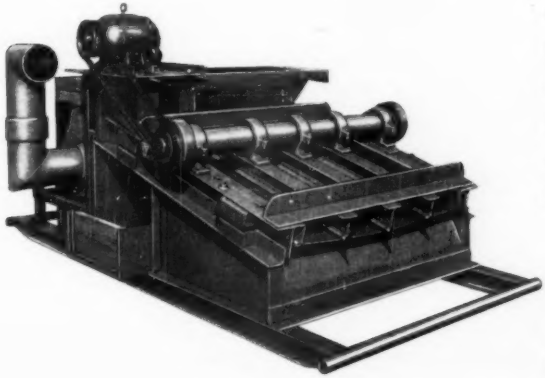

FREE LENGTH OF PIPE IN FEET
PULL IN POUNDS
STRETCH OF PIPE IN INCHES
NOMOGRAPH FOR DETERMINING FREE LENGTH OF PIPE IN A STUCK STRING
FOR 4½"–16.60 lbs. INTERNAL UPSET A. P. I. DRILL PIPE
FORMULA: L=Ke/P
WHERE:
L–FREE LENGTH OF PIPE IN FEET
K–CONSTANT–FOR THIS SIZE AND WEIGHT, K–11,018,000
e–STRETCH OF PIPE IN INCHES
P–PULL IN POUNDS

Fig. 6—FINDING STUCK POINT—Nomograph for determination, applying to 4½-in. drill pipe

A guide on the overshot brings the fish within the slip-catching mechanism of the tool. An upward strain is then taken, thus tending to center the fish within the bore. The overshot is then released and the knuckle joint and fishing tool are withdrawn from the hole and replaced with the wash pipe and rotary shoe. Because the fish is now centered, it passes within the inside diameter of the

Job photo above shows two large model RUMBA Shale Shakers used in parallel on barge job. Below is close-up of one of the big shakers.



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rotary shoe and the confines of the wash pipe. As rotation proceeds, the formation or mud cake tending to hold the fish is drilled away by the teeth on the rotary shoe. After 300 ft. have been freed, the string is withdrawn and the rotary shoe is replaced with the outside cutter.

Outide cutter. — Like the inside tool, the outside cutter is very old and employs similar principles regardless of manufacture (see Fig. 5) All outside cutters embody (1) slips or dogs that catch either on the walls

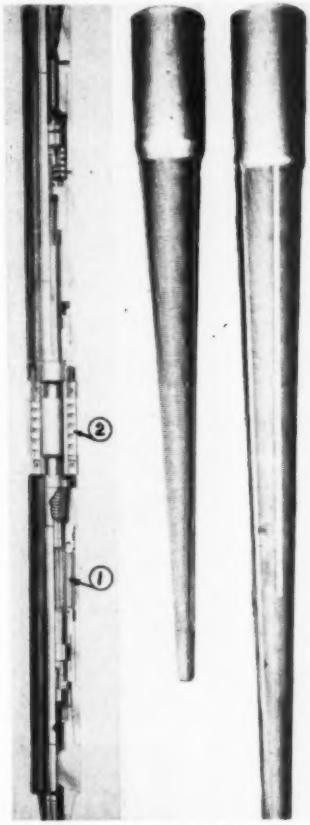

Fig. 7—(Left) REVERSING TOOL—An intricate mechanism of gears, springs, dogs, threads, and other parts that utilize all the available forces within a well. When in use, rotation, motion up and down, mud pump pressure and even inertia are employed in catching, backing out the fish or releasing the tool. Right-hand motion imparted by the operating string is increased 2½ times and transmitted in the reverse direction by the planetary gear system of the tool

Fig. 8—(Right) TAPER TAP—The taper tap is available in all sizes and shapes and is one of the oldest fishing tools in use by the industry

of the drill pipe or under the tool joint when an upward motion is imparted to the string. A force is transmitted through a cushioning spring (2) to a wedge surface (3) that, upon contact with the cutting knives (4), pushes them inward to bite into the fish. Rotation then severs the drill pipe and the overshot mechanism (5) within the cutter carries this free section to the surface as the operating string is withdrawn. The three cutting knives are critical; these must be designed to penetrate the wall of the pipe without binding the tool and the heat treatment must be such as to provide a very hard cutting point with a ductile bearing end to resist the shock loads.

Method of bump shooting.—The use of an explosive detonated inside the drill pipe in combination with a reverse torque taken at the rotary table plus an upward strain thereon is a patented process. The initial operation is that of locating the sticking point. Usually the same type of tool is employed as described previously. However, if this tool is not available, the sticking point can be reasonably accurately located by means of the nomograph shown in Fig. 6.

In using this method, based on the well-known formula for the stretch in steel, L is equal to Ke/P, (where L is the free length, K is a constant, e is the stretch and P is the pull), a strain equivalent to the weight of the pipe is taken thereon and a scribe mark made at a convenient location; an additional strain is then applied and the pipe again marked. The amount of stretch is the distance between the two marks and the pull is the difference between the weight of the pipe and the reading on the weight indicator. By drawing a straight line between these two readings on the nomograph, an intersection is made across the line that indicates the depth of the sticking point.

After the sticking point has been located, the explosive charge and the detonator are run in on an insulated cable. This charge, known by the trade name of Primacord, is of multiple strands and is approximately 30 ft. in length. The entire assembly is run to the desired depth with the aid of weight bars. Previous to the detonation, an upward strain and a reverse torque are applied at the surface to the stuck pipe. Under the influence of the explosive shock, the reverse torque is sufficient to unscrew the joint adjacent to the location of the discharge. The free pipe may then be withdrawn from the hole and alternate washing over and outside cutting operations, as described previously, remove the remainder of the fish from the hole.

Reversing tool.—Under certain restrictive conditions, inside or outside

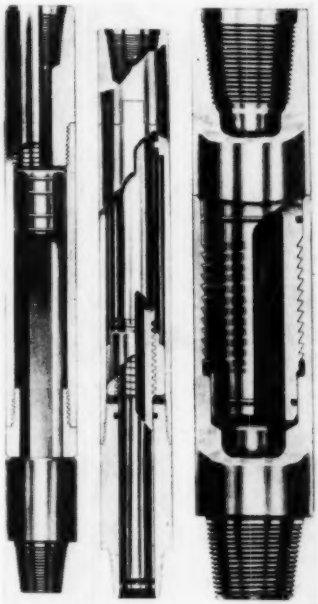

Fig. 9—(Left) MECHANICAL JAR—A simple type of jarring tool is shown. This consists of a hexagonal stem containing a piston with suitable sealing means. When in operation, impact blows are delivered upward or downward by similar travel of the operating string. The seal is necessary to permit circulation of the drilling mud

Fig. 10—(Center) COMBINATION JAR AND SAFETY JOINT—This is a unique tool that serves two functions: that of imparting shock loads to a stubborn fish or releasing the operating string from the fishing tool should the fish remain stuck. This tool is most frequently used above a taper tap

Fig. 11—(Right) SAFETY JOINT—This must transmit the drilling or driving torque yet release or unscrew upon left-hand rotation with 35 to 40 per cent of the original make-up torque. This is accomplished by the clutch shoulder and the buttress releasing thread. The joint is sealed to permit mud circulation

cutting may not be applicable to the removal of the stuck drill pipe. There is another tool available, run on drill pipe or tubing, and with suitable fishing tools, attaches itself to the fish in the hole. This is the reversing tool (Fig. 7). Through a series of planetary gear trains (1), it reverses the direction of rotation and applies a torque increased by approximately 2½ times that transmitted through the operating pipe. The backup for this tool, in providing the necessary left-hand torque to unscrew the fish, is a set of opposing wings (2) that open and "dog off" on the casing.

The grapples or fishing tools used

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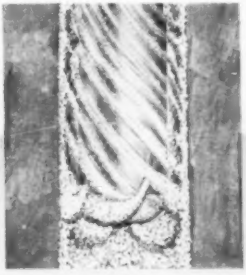
NO OTHER EQUIPMENT—no other method of cementing—provides such assurance of successful "first-time" cementing as the exclusive Baker Principle of "whirling" the cement up and around casing which is effectively centered in the well with Baker Model "G" Casing Centralizers.

Not only can you REMOVE BRIDGES which might stick the casing; not only can you wash the wall of the hole to help REMOVE MUD CAKE and leave the formation prepared for effective bonding with the cement to follow; but the definite *downward*, then *upward* whirling motion of the cement slurry REDUCES THE HAZARD OF CHANNELING TO A MINIMUM, and assures COMPLETE ENCASEMENT OF THE PIPE at the critical shoe joint with a uniform body of cement.

Study the illustrations below for visual proof of what "whirling" means to you.

The downward hydraulicking action of the circulating fluid through the baffled side down-whirler ports, and the nozzle-like bottom passageway, effectively remove bridges and permits safe running of the casing string.

When washing the formation at the cementing point to condition the hole, the "whirling" motion of the fluid helps remove mud cake from side walls. This *downward* whirling is far superior to any *side* jetting action, and does not cause caving or crumbling of soft formations.



The "whirling" motion given to the cement slurry as it is discharged from a Baker Wash-Down Whirler Shoe causes the cement to encase the centered shoe joint with a uniform body of cement, and reduces to a minimum the hazard of channeling.

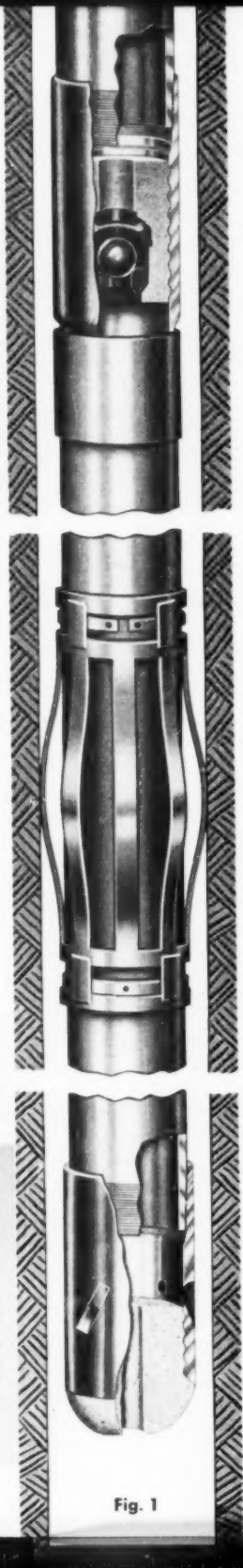


Fig. 1

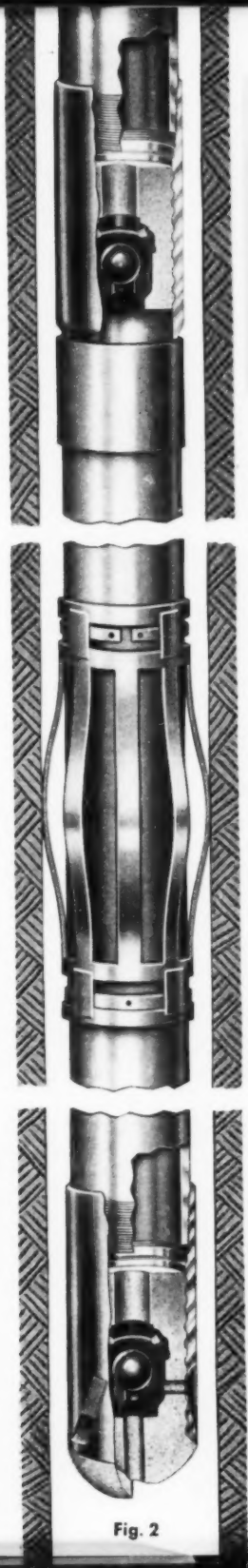


Fig. 2

EVERY cementing job should be performed with equipment which provides maximum FLOATING EFFICIENCY • LANDING EFFICIENCY • CEMENTING EFFICIENCY . . . with COMPLETE DRILLABILITY and PROVEN DEPENDABILITY

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RESULTS ARE WHAT REALLY COUNT

You are assured of RESULTS when you use Baker Hook-Ups like those pictured at left. For wells up to average depth, use a Baker Cement Wash-Down Whirler Guide Shoe (Product No. 121) with Baker Model "G" Casing Centralizers (Product No. 910-G) spaced throughout the cementing area to provide *maximum centering force at the cementing point.* Then with a Baker Cement Float Collar (Product No. 101 M&F) positioned a joint or two above the shoe, you have the world's best "float valve" for safety, plus a "stop" for the cementing plug so that cement tailings are retained inside of the casing. See Figure 1.

For deeper wells, where maximum "floating" strength is a worthwhile precaution, a Baker Cement Wash-Down Whirler Float Shoe (Product No. 120) used on the bottom of the string (Figure 2) gives double safety at negligible cost.

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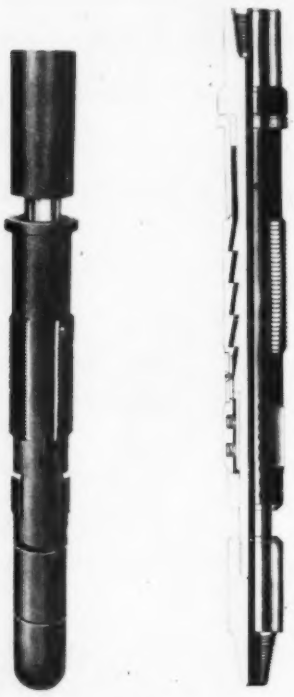

Fig. 12—THE SPEAR—Composed of three principal parts: a clutch, slips that expand on a tapered mandrel, and friction blocks that permit the operation of the clutch. If run in conjunction with the inside cutter, a tool joint connection is attached to the bottom

with the reversing instrument may be either especially designed taper taps, overshot, or spear; each must be capable of resisting rotational torque.

Fishing for Drill Pipe, Drill Collars, Etc.

The tools available for the recovery of pipe lost through twistsoff, unscrewing, or other equipment failures fall principally into two categories: (1) those that go inside the fish and attach themselves thereto and, (2) those that go over the outside diameter and attach. In the first group are taper taps and spears. The second group consists of box taps and various types of overshots.

Tapered and box taps.—The tap is perhaps the oldest fishing tool and is still frequently used. There are many and various-sized shapes of taps; usually the taper tap (Fig. 8) composes a long "snoot" that is small on the penetrating end and increases by a taper of ¾ in. per foot to the diameter of the tool joint box of the other end. Carburized threads cover the entire length (except the joint) of the tool; upon rotation these cut new threads into the fish and bind together.

Because the tap cannot be easily released, a safety joint or a safety joint and jar combination (Figs. 9, 10, 11) are usually run in conjunction with this tool. Should the fish remain adamant and the tap refuse to release, the jar may be utilized to provide upward impact. Should this fail, the safety joint may be released by left-hand rotation and the fish removed by subsequent washing-over and cutting operations.

The spear.—Because of its releasability, the spear (although not as strong) is more desirable as an inside fishing tool than the taper tap (Fig. 12). It is composed of friction blocks that contact with the walls of the fish and slips that expand on a tapered mandrel much in the same manner as the parts of the inside cutter. A J-slot clutch mechanism, when rotated one-quarter of a turn, either permits the slips to set or holds them in releasing position.

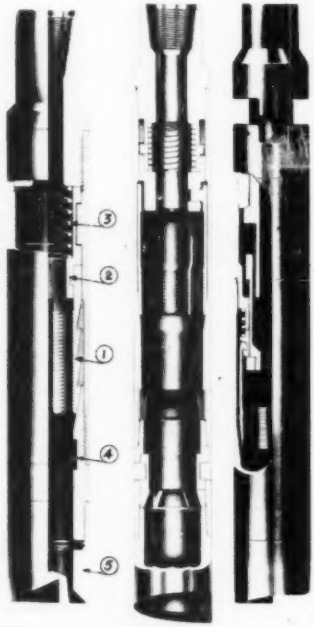

Fig. 13—(Left) MULTISTEP OVERSHOT—This tool is essentially a spear turned inside out. Such additional parts as guides, packoffs, and mills may be included in its makeup. This is an example of a multistep slip type of overshot

Fig. 14—(Center) TOP-LOADING OVERSHOT—This is an easily assembled type of tool, with an integral mill above the guide

Fig. 15—(Right) JACKSCREW OVERSHOT—This tool permits release of the fish without application of weight

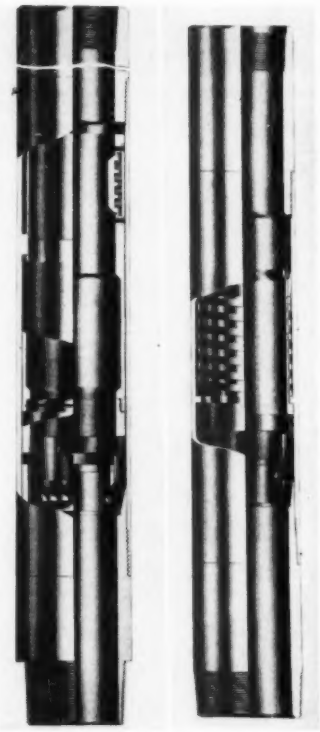

Fig. 16—WASHOVER OVERSHOTS—Slips in these tools catch beneath tool joints to recover the fish. Rotation and washing over can be carried on with these tools in the string

The overshot.—The usual overshot is composed of slips that expand on a tapered surface and are suspended from a clutch block arrangement that usually involves a J-tool. Such an overshot is shown in Fig. 13. The slips (1) are held by the clutch block (2) which is slidable under the action of the spring (3). This particular overshot has a multistep taper that permits multiple points of contact. Such an arrangement is more easily released. This overshot is also equipped with a rubber packoff (4) and a guide (5) for directing the top of the fish into the interior of the pool.

In operation, the top of the fish enters the tool and contacts with the corrugated face of the clutch block; the slips slide back as the fish enters. After movement is stopped, the fish has penetrated as far as possible and the spring forces the slips securely against the walls. An upward

motion of the operating string then causes the carburized teeth of the slip to bite firmly into the fish and anchor the overshot.

If the fish remains stuck, the overshot may be released by applying weight down, thus forcing the slips to release and turning the J-tool arrangement holds them inoperative. Another adaptation of the overshot is shown in Fig. 14. This tool contains a single tapered slip and has an added feature of a mill in place above the guide. The advantage of this tool is its simplicity in dressing on the rig floor.

The usual type of overshot requires sufficient weight downward to knock the slips loose and thus release the tool. The overshot shown in Fig. 15 contains a jackscrew arrangement that permits release without weight applied; this tool may be used for fishing just below the grass roots. Right-hand rotation causes the jackscrew to lift the slips off of the wedge surface, releasing the fish and holding the slips out of catching position.

In washing-over operations, it is occasionally necessary to permit the fish to travel through the interior of the fishing tool, in which case a washover overshot is placed in the wash pipe string. Examples of such an overshot are shown in Fig. 16. A J-tool clutch arrangement and slips for catching over the tool joint are provided. While right-hand washing-over operations occur, the slips permit passage of the pipe and tool joints. As soon as it is desired to catch the fish, the wash string is raised until the slips catch under the tool joint and bring the fish to the surface. If the fish refuses to move, the string is lowered until the friction blocks contact with the tool joint. This raises the slips out of the tapered section and left-hand rotation causes the J-tool to lock and hold them in release position.

Liner and Miscellaneous Tools

The rehabilitation of old wells involves principally the removal of subsurface production equipment such as packers, liners, and screens that have become clogged with the producing sand or other impediment. In wells that have been producing for many years, this sanded-up condition will firmly hold the subsurface equipment in place. In order to release the tubing and remove the obstruction for cleanout work, it is necessary to sever the string with the inside cutter at some suitable point and continue to remove this in sections until the hole is clean. A recent innovation of a subsurface hydraulic jack, used in conjunction with a suitable fishing tool, also may be utilized in this procedure.

Inside cutting of liners.—After the tubing and subsurface lifting equipment are withdrawn, the liner must be removed. Usually, a spear is run above the inside cutter and on the same operating string; this is usually the tubing previously taken from the well. If a packer is in place above the liner, the first cut must be made here before it will release. After the packer has been severed, the assembly is lowered; the cutter passes through and a bumper ring on the spear prevents this tool from going further than catching position. The spear is set in the packer and an upward strain removes the severed parts. After the packer has been released, it is often necessary to make many cuts in the liner (sometimes removing sections as short as 6 in.) until the hole is clean. Thus, many trips are frequently required and some rehabilitation jobs become very lengthy.

Hydraulic subsurface jack. — Because only a limited strain can be placed on the workover gin pole or small derrick, the cutter-and-spear method handicaps the operator in that the required pull to remove the liner cannot be applied. A recent development that overcomes this handicap is the subsurface hydraulic jack. This tool anchors to the liner and, through slips, applies the strain to the casing set within the hole. Thus, no load is placed on the gin pole at the surface. Occasionally damage to the casing has resulted where the original cementing job was not sufficient to resist the load applied by the jack; however, where the casing seat is adequate, this tool has successfully and economically aided in such rehabilitation work.

The tool is run on tubing or drill pipe and uses a spear on the bottom to engage the liner. The slips of the jack are set in the casing. Hydraulic force is applied through surface pumps to a multiple series of pistons and cylinders in the tool that increases the force of this pressure any desired amount up to a multiple of 10. Thus, a tremendous upward thrust may be placed on the liner.

Window milling.—Another rehabilitation operation is that of plugging the old hole, milling a window in casing, and directing the bore to angle through this aperture to a new bottom location. One type of milling operation involves a whipstock that is attached to the walls of the casing by means of slips. The inner channel of this tool then guides cutting teeth of a mill into the adjacent casing and removes this metal for the length of the whipstock. After the mill is replaced by the drilling bit, the whipstock remains in place and directs the bit through the window previously milled in the casing.

There is another type of window milling tool that does not require the wedge surface of a whipstock. This tool, containing multiple sets of milling knives, first cuts through the casing around its entire periphery and then mills out a complete section of any desired length. The pump pressure forces down a piston that expands the cutter knives. As the tool is rotated, the knives cut and mill in successive operations. The cuttings are carried to the surface by circulation of the mud. After the section of casing has been milled out, it is necessary to set a whipstock adjacent to the window to direct the drilling bit that follows.

Miscellaneous

Cemented pipe.—It happens quite frequently that tubing or small conductor pipe inadvertently becomes cemented. This cement may be on either or both sides of the conductor pipe; if on the inside, it is drilled out by means of diamond point bits and small operating pipe. If on the outside washing-over operations are required. After the cement has been drilled up, the cutting tools are usually needed to clean the hole. On jobs of this nature the power swivel is particularly adaptable in providing the rotational force for the bit drilling out cement inside the pipe.

Underreamer.—Enlarging the gage of the bore hole is frequently necessary in certain fishing operations. For instance, if the top of the fish, leaning to one side of the bore, refuses to enter the guide of the fishing tool, it is often necessary to underream or enlarge the hole just above this point. The reaming tool is composed of two blades that expand outward under the influence of mud pressure applied from the surface. As these blades expand, rotation causes them to ream the hole to the desired diameter. The top of the fish may then be reached by the fishing tool.

Key-seat wiper.—In formations susceptible to the creation of key seats (irregular enlargement of the bore on the "high side" due to constant rubbing of the pipe or drill collars) a tool to prevent the drill collars from sticking at such points is often included in the drill string. This tool is known as the key-seat wiper and is run just above the drill collars. It consists of a slidable sleeve or blocks attached to a mandrel. Usually, the shoulder of the slidable member is larger than the diameter of the drill collars and thus enlarges or shears formation from the key seat and permits free passage of the drill collars.

Suitcase Laboratory

(Continued from page 172)

such as wires, chemicals, balances, and titration and chloride apparatus.

The same pieces of equipment used in a truck-mounted laboratory are used in the suitcase lab. However, some of the equipment has been redesigned to reduce space and weight requirements. In particular, the stills and retorts have been redesigned so that smaller samples of core can be used and the same accuracy achieved as that of more bulky equipment.

Unit 4, as described above, has a water and an air tank in the top of the box, both of 3-gal. capacity. The motor that drives the grinder and other electrical equipment also furnishes power for a small air compressor. This compressor supplies air for the permeability apparatus and also provides pressure for the cooling water system. A small standby compressor is also included with the permeability apparatus in Unit 1 making it self-contained.

Although the laboratory is small in comparison to the conventional truck-type unit used for normal land operations, it can analyze cores just as rapidly and accurately. This is possible because of the increased efficiency of the suitcase lab equipment.

Suitcase Laboratory No. 2 is already being built by Core Lab as a result of the successful field use of the initial unit. As to the future, the designers believe that, in addition to its use on a service basis, there is a possible sales market for the unit. The lab could be sold to operators in foreign fields where core-analysis service companies are not available.

More Footage Drilled With Fewer Rigs

(Continued from page 183)

total demand for the year. Reserves that are high in proportion to demand create a pressure for excess crude production which in turn disrupts the product market. If demand increases faster than reserves, shortages develop.

Demand in 1948 increased about 4 per cent. In normal times we would expect an increase in reserves of about 4 per cent. However, curtailed drilling during the war years prevented normal gains in reserves, leaving a backlog of drilling needed to bring reserves into a better relationship with demand. The record drilling in 1948 added 8 per cent to proven reserves of crude and light products, 4 per cent to cover the demand increase, and 4 per cent credited against the deficit accumulated during the war years.

Demand in the early months of 1949 was below normal because of the very mild winter and for the year, total demand is forecast at about 2 per cent above 1948. Operators have said that they expect to drill about 0.5 per cent more hole this year than last. If the ratio of new oil found to footage drilled is near normal, most of the war-produced deficit should be eliminated.

If total demand in 1950 increases 4 per cent over 1949, the new oil needed to meet this demand and to give the same percentage increase in reserves will amount to about 3,250,000,000 bbl. This is based on imports at about the current rate. To find this much new oil from new discoveries and further development of past discoveries will require at least 132,000,000 ft. of hole. A slight drop in the ratio of new oil to footage would call for as much as 140,000,000 ft.

The amount of oil found for each foot of drilling varies by areas and also by years. The smallest return is in the North Central and Eastern areas. However, these areas have shallow wells and the drilling cost per foot is below the average. This also includes Pennsylvania Grade production with crude prices well above the average for the rest of the country.

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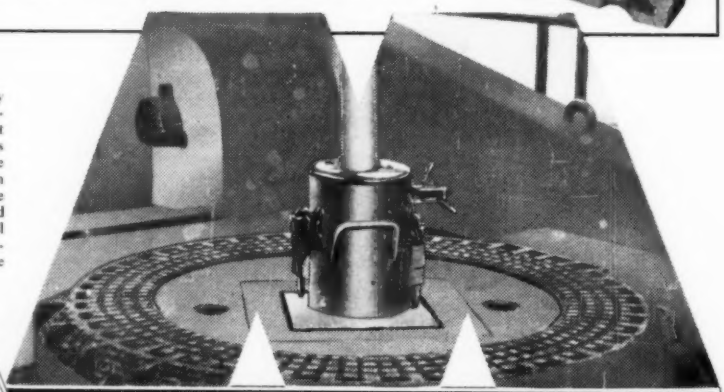

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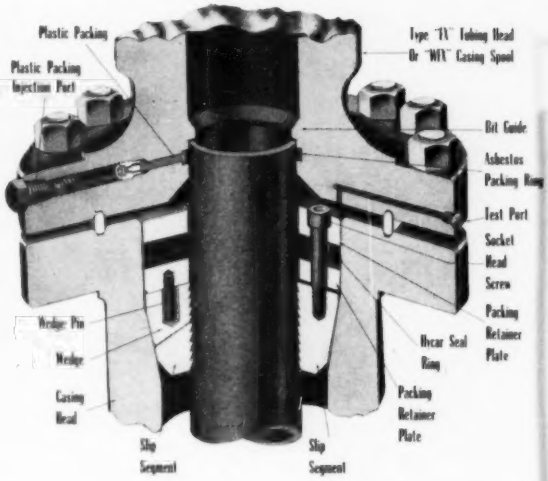

Sectional view of hanger with Type "FX" tubing head installed above.

Hanger assembly in closed, or latched, position.

Hanger assembly in unlatched position.

Hanger installed in casing head. Note split setting guide which has served its purpose and may now be discarded.

As illustrated herewith, the Cameron Type "A" Automatic Hanger assembly consists of 6 slip segments which are attached to the two halves of a hinged packing assembly, with a setting guide on top. Each slip segment carries a wedge which, in the free position, projects slightly beyond the tapered surface of the slips. The bottom of these wedges bear on inclined planes in the slip segments and the top of the wedges bear on the lower packing retainer plate. Upon reaching its seat in the casing head, the outer taper on the wedges contact the casing head taper and the slip teeth engage the pipe. As pipe load is slacked off onto the hanger the wedges are forced inward and upward on the inclined planes, forcing the lower packing retainer plate upward to compress the packing.

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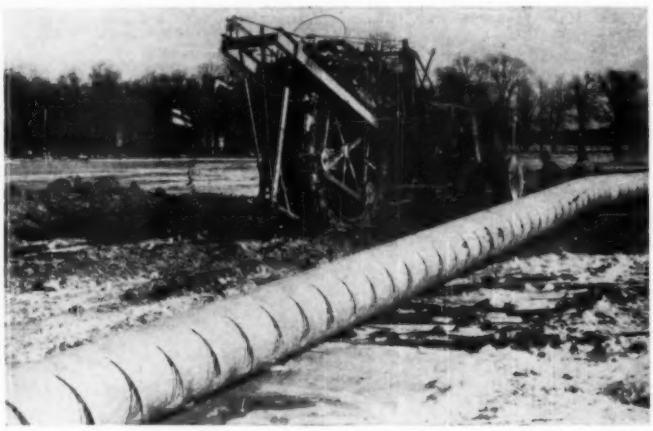
drilled followed in order by California and the Arkansas-Louisiana-Mississippi area.

If the major portion of this country's demand is to be supplied from indigenous production, well completions and footage must increase with gains in demand. The trend toward deeper drilling will probably continue. As profitable production is found from the deeper horizons, development drilling in these areas will boost completions in the deeper classifications.

At the present, very deep wells are not important from the standpoint of numbers but make the news because they are the record setters. They act as a proving ground for new equipment and techniques. Few geographic frontiers remain for the driller. He has drilled in the frozen areas of Alaska and in the deserts of the Middle East, in the Rocky Mountains and in the open waters of the Gulf of Mexico, in the heart of cities and in the waste lands of foreign countries. Currently the big challenge to the driller is found in the lower formations in deep sedimentary basins. Do these deeper zones contain oil? What changes must be made in drilling equipment and methods to go down 25,000 ft.? Can ultradeep production be profitable? Depth is still a drilling frontier.



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KOPPERS BITUMASTIC ENAMELS

A. A. O. D. C. Constantly Broadening Its Activities

(Continued from page 155)

ganization and Control, (2) Building a Personnel Organization, (3) Management's Opportunity in Accident Prevention, (4) Application of Cost Factors in Contract Drilling, (5) Security Programs for Drilling Personnel, and (6) The Legal Position of the Drilling Contractor. This comprehensive program was so well received by those attending the series that a similar conference is planned for 1950.

Most recent undertaking of the A.A.O.D.C. is the school for care and maintenance of drilling engines which was started at Odessa, Tex., last July. Designed for field personnel who handle drilling engines, the 3-week course emphasizes how to start, operate, and stop diesel, gas, and dual-fuel engines. In addition to laboratory work, lectures, and question-answer periods, reports by engine-manufacturer representatives are given and training films shown. The course is being offered at Odessa College under the joint sponsorship of the association, University of Texas, and the State Board of Vocational Education.

Another training program recently undertaken by the A.A.O.D.C. is its employer-unit conference training program in the West Texas area. In this program a contractor selects 3 to 10 of his supervisory personnel to attend the conferences, which have the dual purposes of promoting better safety habits and improving field supervision. The conference work is conducted by the industrial and business training bureau of University of Texas. The over-all plan is under the administration of the contractor's educational committee, headed by C. J. Paine of Dallas.

Since one of the primary aims of the project is to lower accident rates, and thereby reduce the individual contractor's basic rates for insurance coverage, the association is being aided by leading casualty underwriters. Two firms, Texas Employers Association and Employers Mutual Liability Insurance Co., are contributing 0.5 per cent of the annual premiums received from drilling contractors. Other underwriters are expected to participate as the program is expanded to other areas.

To date four contracting companies in the Midland area have formed groups to participate in these conferences. These are Carl B. King Drilling Co., W. H. Black Drilling Co., M. J. Delaney Co., and J. E. Postell Drilling Co. Each company pays one-third of the service costs, with equal sums being paid from the underwriters' fund and by the State Board of Vocational Education.

The A.A.O.D.C. special committee on contractural liability provisions in

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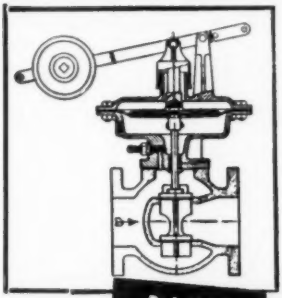

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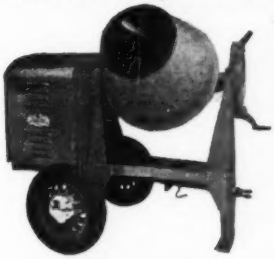

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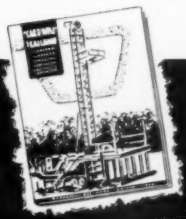

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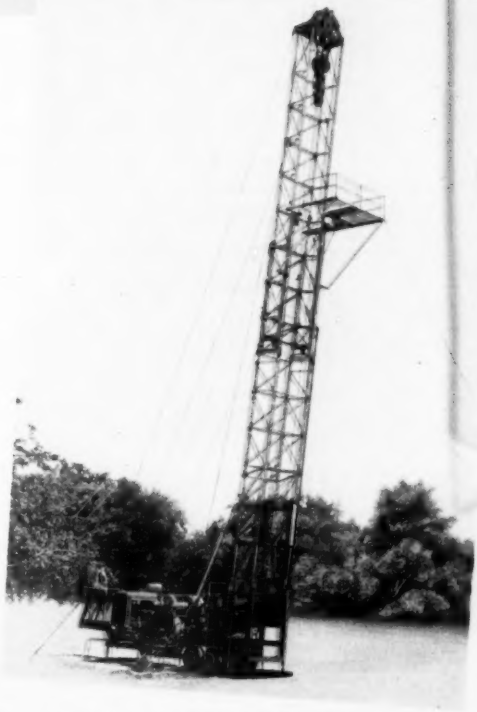

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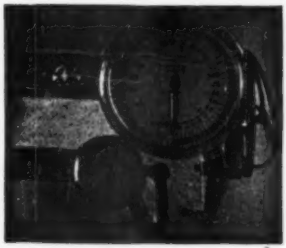

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drilling contracts, headed by A. H. Rowan of Fort Worth, in the past few months has done much to improve the contractor's lot. This group, assisted by similar committees from the American Petroleum Institute and Texas Mid-Continent Oil and Gas Association, has succeeded in eliminating "hold harmless" clauses in the standard contracts of several major Texas oil companies. It also performed a great service to Texas drilling contractors in general earlier in the year by being instrumental in opposing excessively high insurance rates for coverage on liability resulting from underground damage. The committee currently is continuing its work toward the removal of hold-harmless clauses from all drilling contracts, and is progressing in its work on standardized contracts.

Safety Program

One of the most active of the association's 15 general committees is its safety group. Well aware of reduced insurance rates and operating costs which result from the industry having fewer accidents and deaths, the A.A.O.D.C. since its inception has plugged safety and accident prevention. Interest aroused by its program is best illustrated by the record attendance which turned out for the annual Safety Clinic last May.

Some of the committee's most valuable work has been in encouraging and assisting rig-crew safety meetings. These crew meetings, where they study and discuss hazards and their elimination, are the backbone of the drilling-industry safety program. To assist the driller in the training of his crew the committee has prepared a series of safety bulletins entitled "Safety and the Driller." These are now being distributed throughout the drilling industry.

Other safety services offered by the group include its safety color code, safety posters, inspection check sheets for rotary rigs for periodical checks of drilling equipment, and recommended safe practices to be followed while making drill-stem tests. It also is revising a safety manual which is a rotary-drilling handbook on safe operating practices and accident prevention. As a further incentive for safe operations the association now presents drillers with a "No Lost-Time Certificate" if neither he nor his crew suffers any injury during a 12-month period.

The association's mud-control training course, started in 1947 in West Texas, was expanded into Canada, the West Coast, and other oil areas during the year. In these mud courses the work is centered around the laboratory school, with the men generally attending 2 hours daily, 5 days per week for 5 weeks. The course is designed specifically for roughnecks, derrick men, tool pushers, and others interested in drilling-fluid handling and control. The Canadian mud school was first held at University of Alberta, the Edmonton school working in cooperation with the A.A.O.D.C.

This mud-training program has done as much as any single association project to convince drilling contractors of the improved operations they may gain from affiliation with an industry-wide organization. Such special training of employes generally is too large for any single operator to undertake. Final proof of its widespread acceptance is the fact that more than 5,000 men have taken the course since it was first started less than 3 years ago.

Another training program sponsored by the A.A.O.D.C. is the drilling-practice course being offered at Kilgore College in East Texas and at Long Beach City College in California. This course is designed to give students a practical course in oil-well drilling operations so that upon graduation they will be thoroughly qualified to fit into such occupations as roughnecks, drillers, tool pushers, and superintendents of drilling operations. The courses now being offered extend over a 2-year period.

From the foregoing account it is readily evident that the A.A.O.D.C. is steadily broadening its activities in an effort to assist drilling contractors in becoming more efficient and more safety conscious in their operations. As executive vice president, Brad Mills oversees the administration of the training programs. J. Doyle Set-

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tle, association secretary, correlates the group's safety program, while Kye Trout serves as director of field and engineering activities. Other members of the association staff in the Dallas headquarters are Jack Westsmith, who directs public relations and membership work, and Ed DeWeese, editor and advertising manager of the association's magazine "The Drilling Contractor."

New Developments in Drilling Equipment

(Continued from page 157)

engines suitable for use on power drilling rigs. Light-weight, high-speed diesel units equipped for dual-fuel operation have found side acceptance by drilling operators and oil producers. Hydraulic drives, in the form of hydraulic couplings and torque converters; radially operated air clutches for use in frequently engaged and disengaged rig drives; and air controls of engine throttles, clutches, hydraulic couplings, and other services have also been developed by the industry in recent years.

Improved drilling muds and hydraulics.—The industry's studies of drilling muds and hydraulic systems are also contributing continually to better drilling techniques. Recent developments include wider applications of oil-base muds in well completions and wider use of starch muds, sodium silicate muds, carboxymethyl-cellulose, etc., to combat drilling problems encountered in areas that cannot be drilled with natural or lightly treated drilling muds.

Development of these new muds makes it possible to drill oil-bearing formations below the heaving shales which drillers could not penetrate with regular drilling muds and former techniques. Today, heaving shales are not a barrier to the development of many oil fields, and the use of improved muds has thus permitted substantial additions to our crude-oil reserves.

The most important new developments in drilling soft to medium-hard formations are increases in circulation rates and higher bit-nozzle fluid velocities to improve penetration rates. Heretofore, improvements in bits consisted largely in design changes of cutting edges and the use of better steels to allow a maximum amount of hole to be drilled between bit changes. Present-day commercial-type drag bits are equipped with heat-treated drop forged steel blades and tungsten carbide inserts applied to the face and edges of the blades. The drilling fluid nozzles in most current designs are replaceable steel alloy tubes, usually one per blade, ranging in size from 7/8 to 1¾-in. bore. This design usually results in fluid nozzle velocities of 50 to 200 ft. per second.

Penetration rates.—Some recent experimental work has established two new hydraulic relationships in drag bit drilling. The first is that penetration rates are directly proportional to the circulation rate when the nozzle velocity is constant. Second, the rate is directly proportional to the nozzle fluid velocity at constant circulation rates. These studies and relationships point out that the fastest rate of drag-bit drilling with any particular rig can be obtained when all the horsepower available on the rig for mud circulation—above that required to maintain a safe annular return velocity—is used to increase the bit-nozzle velocity. Thus far these investigations have included two-blade drag bits at rotary speeds, and the application of higher fluid nozzle velocities to rock bits are being investigated.

In general, recent developments in this line appear to indicate that in soft drilling with fishtail bits, high circulation rates, and high nozzle velocities, in combination with moderate weight on the bit and moderate rotating speeds, will provide high rates of rock penetration. In drilling medium or moderately hard formations, high rotary speeds—up to 400 r.p.m.—in combination with higher

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circulating rates have substantially increased penetration rates. In hard-rock drilling the best practice appears to be a combination of relatively high weight on bottom with moderate rates of mud circulation and normal rotary speeds.

Other Improvements

The application of diamond-core bits and core barrels by the petroleum industry was stimulated by operations in Rangely field, Colorado, a few years ago. In that field diamond coring was used to overcome the difficulties met in drilling through a producing section of extremely hard Weber sandstone approximately 750 ft. thick. The successful application of diamond core bits and core barrels provided full information on the entire producing formation. In addition, it resulted in substantial savings to the operator, for in this instance diamond coring proved to be cheaper than regular drilling.

Recently diamond bits have been used to penetrate extremely hard formations, such as silicious sandstone, chert, hard sharp sand, and dolomitic limestone. In these instances diamond-core bits are used instead of regular rock bits in routine drilling operations. The resulting cores are an extra advantage.

Improvements in side-wall sampling equipment have given the operator considerable assurance that, in the event prospective oil horizons are missed during rapid drilling operations, he can secure suitable formation samples after reaming and electric logging the hole. Among the many devices recently developed for this purpose are (1) punch-type side-wall samplers, (2) percussion-type samplers, (3) mechanical rotary-type coring tools, and (4) electrically driven side-wall samplers. The equipment and techniques for side-wall sampling are fast enough and dependable enough to procure samples from either soft or hard formations at any interval of the well.

Mud logging is a method of evaluating and identifying oil and gas shows in formations being drilled. A recent improvement in gas-detector design makes it possible to determine the percentage of methane separately from hydrocarbons of higher molecular weight. The method is very reliable, but unfortunately it gives only a qualitative evaluation of the formations. It is also the most expensive of all logging methods.

Rate of penetration, caliper, and temperature logs also provide useful information leading either toward better drilling, or evaluation of various factors in connection with cementing and well-completion operations. Geochemical and fluorographic well logging have received some attention, and have been used commercially, but are not yet considered very important. The principal claims made for these methods are that they can

predict the presence of gas and oil considerably ahead of the drill. The validity of this claim has yet to be proved.

As we all know, oil wells used to be completed in the first oil-producing sand penetrated by the drill. The object of cementing in early drilling operations was to place an impervious seal at the casing shoe, between the casing and the wall of the bore hole. Today, however, the procedure often is to drill through several producing horizons, set casing through all the producing sands found in such drilling, and to seal the annular space between the casing and the bore hole to a point at least 500 ft. above the topmost producing zone.

To meet these conditions, as well as other problems of well-cementing arising from deeper drilling, it has been necessary to improve cementing equipment and technique. During the last 10 or 15 years the industry has developed stage cementing, squeeze cementing, bulk cementing, and plastic cementing. (The application of plastics in place of cement is generally confined to work-over or remedial use.) Numerous new tools, such as wall scratchers, screens, packers, and stage and bulk cementing equipment have been invented, and better cements have come on the market. Among the new cements now available are acid-soluble, quick-setting, slow-setting, gel-type, and high-temperature cements. The recent successful cementing of 7-in. casing between 19,000 and 20,000 ft. in Wyoming is indicative of the developments in equipment and technique.

Until the advent of plastics, regular oil-well cements were used in repair and remedial work in oil wells. Now, however, a substantial part of this work is performed with the aid of thermosetting plastics which are available in temperature ranges between 70° and 300° F., and setting-time ranges of 1 to 16 hours. Plastics have good bonding properties and can easily be injected into the pores and fractures of formations. They can be introduced into the well either in pure state or in mixtures, by either bailer or pump methods.

Increasing Costs

In spite of improvements in drilling technique and drilling equipment which, together, have contributed greatly to improved efficiency and reduced drilling costs, the average well-drilling costs have more than doubled in the last 10 years, in this country. This increase has been due to higher wages, higher investment costs of drilling equipment, higher cost of materials and supplies, and the greater average depth of wells.

Production from 10,000 to 12,000 ft. is now fairly extensive. There are over 125 oil fields producing between these limits, demonstrating the practicality of such wells. It was reported that as of December 31, 1948, the United States petroleum industry had drilled a total of 561 wells below 12,000 ft. Of these, 3 were drilled between 17,000 and 18,000 ft.; 5 between 16,000 and 17,000 ft.; 13 between 15,000 and 16,000 ft.; 45 between 14,000 and 15,000 ft.; 95 between 13,000 and 14,000 ft.; and the rest between 12,000 and 13,000 ft. Of the 561 deep wells we have drilled, 284 were drilled in the last 2 years. The drilling of these wells has resulted in the discovery of 32 fields, 14 of which were discovered in 1948.

When we begin discussing the cost of these wells, we must remember that well-drilling costs are approximately proportional to the number of days required to drill a well. This, in turn, depends to a great extent on the hardness of the formations that are penetrated. In 1948, the drilling time for 149 wells below 12,000 ft. averaged 162 days per well, an improvement of 18 days compared with 1947.

Assuming that the operating cost of a deep rig is $2,000 per well per day, the average cost of deep wells in 1948 was about $325,000 per well. This is a reduction of $36,000 per well, or slightly more than 10 per cent, compared with 1947.

Most of our deep drilling today is carried on in the Texas-Louisiana coastal area where formations are soft. These two states accounted for about 75 per cent of all of the deep

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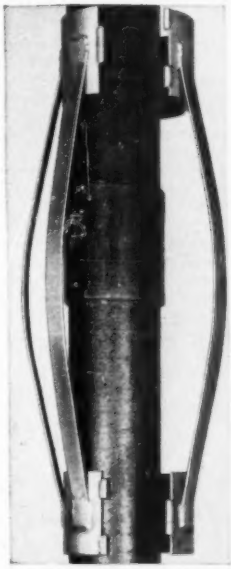

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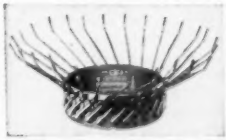

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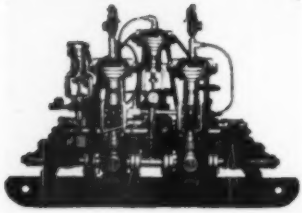

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wells drilled in 1948. To be economically successful, producing zones in hard formation areas must be of the highest quality in order to compensate for the high drilling costs. Deep drilling costs in hard formations are estimated to be 50 to 150 per cent greater than those in soft formation areas.

Relative costs and drilling times of soft, medium hard, and hard deep-drilling operations in the United States are illustrated by the following summary of 1948 averages.

	No. of wells	Average depth	Days to drill average well	Estimated cost at $2,000/rig /day
Louisiana-Texas (soft)	100	13,057	158	$316,000
California (med. hard)	12	13,383	280	$560,000
Oklahoma (hard)	7	13,323	357	$714,000

We expect that drilling operations outside the United States will be substantially more expensive than those above. Such operations are increased by transportation charges when equipment from the United States is shipped, plus the cost of moving heavy equipment where roads and railroads are not available, and the expense of maintaining camps, shops and other facilities in the field. It is estimated, therefore, that drilling costs under such circumstances may be increased by 50 per cent or more.

The Drilling Contract

(Continued from page 162)

or damage to its property growing out of or incident to contractor's operations under the contract . . ."

Practically everything that occurs around a drilling rig is "incident to or arises out of" the operations. The extent of assumed liabilities under this clause, both as to personal injuries and property damage, has not yet been fully explored, and as before the Elliff doctrine, will cover elements of risk and damage not presently enumerated. By such a broad, all-inclusive clause, the contractor in effect underwrites the whole show.

The contractor is not an underwriter, never has been, and should not be. He should be responsible for his own negligence and the negligence of his employes, but he should not be contractually required to pay for the company's negligence or the negligence of company employes, or for the company's concurrent negligence. . . .

Elliff Doctrine

The Elliff case (Elliff vs. Texon Drilling Co., et al, 210 S. W. 2nd 558) announced new principles of law that amount to modification of the familiar "rule of capture." The contractor is primarily liable not only for underground trespass and damage to the reservoir but also for the value of the lost products which escape as a result of the contractor's negligence. The contractor's potential liabilities under the doctrine of this case are enormous. These liabilities are primary and direct and imposed by law, but when coupled with the hold-harmless clause, the contractor must respond directly for his own negligent acts and indirectly for the negligent acts of the company.

Insurance.—The drilling contractor is in a dilemma: he is exposed to unlimited liabilities on the one hand and cannot economically insure against the risk on the other. While the insurance market has changed to some extent, I have seen one domestic quotation on a 20-rig operation amounting to $180,000 annual premium for $100,000 coverage. Such a premium is excessive and the coverage wholly inadequate for a catastrophic loss.

The contractor cannot prudently take the risk of direct liability, and particularly the risk of assumed liability; so even though the company may not require insurance coverage, the contractor should consider the business advisability of securing insurance protection or else run the risk of having the earnings of a life time wiped out as a consequence of

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some momentary act of omission or commission. The hold-harmless clause should be amended so that the contractor would be liable only for damages resulting solely from the negligent acts of the contractor or his employes during the time the contractor has the right of control over the operations. Should the company desire the contractor to assume any additional liabilities for underground damage or for value of lost products, the risk assumed should be covered by specified amounts of insurance, the indemnity limited to the amount of insurance specified, and the cost of insurance added to the contract price for the work performed.

Miscellaneous Changes

In so many instances the printed contracts are modified by odd riders, piecemealed amendments, and exceptions which lead to conflicting and ambiguous provisions when the whole instrument is considered; and in many instances, the difficulty in interpretations force across-the-table settlements after the work is completed. At times, the ambiguities and the unsaid portions of the contracts make analysis of risk and accurate billing and accounting difficult and provide a field for disputes which ought to be avoided.

While no contract could be designed to blanket all situations, clarity and completeness would certainly improve most of the contracts currently in use. Clarity and completeness—who does or pays for what, when, and where — would help the contractor analyze and evaluate each job and if the risks are equitably apportioned, will improve the relationship between company and contractor, and in the end will save the companies money. . . .

In advocating a thorough renovation of the drilling-contract form, the contractor is motivated by a firm belief that the accomplishment of this objective would materially aid him in improving his service to the operator and would inure to their mutual benefit.

A contractual agreement which is clear and explicit as to the equipment to be furnished by contractor, the nature and extent of the service to be performed, and a definite and unmistakable pattern for the distribution of the specific risks and responsibilities, would undoubtedly improve the entire atmosphere and relationship between the operator's representatives and the contractor's organization—from the field personnel to the executive officers. Such an agreement would enable the contractor intelligently and capably to prepare his estimate—and properly to evaluate costs and risks of the undertaking, resulting in the submission of a more favorable price to the operator. Throughout the job, minor difficulties occasioned by uncertainty in the contract would be minimized. Upon completion, charges and billing could be prepared with a substantial savings in time and avoidance of needless corrections. . . .

Therefore, without presuming, nor intending, to write the contract for the operator, it is earnestly submitted that the oil operator, through his executive branches, should outline and approve the basic principles for the new form of drilling contract, patterned along the lines and general principles, customs, and practices herein referred to, and that the legal department of the operator should be instructed to incorporate these principles into a new type of drilling-contract form.

Fast Drilling Rate

(Continued from page 160)

exceptionally fast rotary-drilled wells is in order. Also that drilling rates for the Turbodrilled well be compared with those of nearby rotary-drilled wells in Golden Meadow field. These comparisons are shown in Tables 2 and 3.

Table 2 shows the net drilling time required to drill six Gulf Coast wells with conventional rotary. For all of these wells, drilled in 1948 or earlier this year, the drilling times are believed to be the fastest achieved to date in the fields where they are located. Certainly they are well below the average time required in their respective fields.

Of particular note is well A in St. Landry Parish, Louisiana, which was drilled to 5,000 ft. in 4 net days or at the rate of 1,250 ft. per day. At No. 7 Cheramie the potential drilling rate of the Turbodrill was 2,500 ft. per day, or 100 per cent greater, while the turbine was delivering only 40 per cent of its maximum rated horsepower.

TABLE 2—NET DRILLING TIME OF SIX ROTARY WELLS

Well and location—	Net drilling time, days	Footage	Average footage per day
A—St. Landry Par., La.	4	5,000	1,250
B—St. Landry Par., La.	9	6,500	723
C—Calcasieu Par., La.	14	8,850	631
D—La Fourche Par., La.	18	10,500	584
E—Terrebonne Par., La.	23	12,000	522
F—Adams County, Miss.	26	10,000	385

On five wells now drilling or recently completed and closely offsetting No. 7 Cheramie, comparison at the same depths also is possible between the two methods. The formations penetrated in drilling all six wells were practically identical. Electric logs correlate very closely. Geograph logs, drilling reports, and bit records on the six wells were analyzed in making the comparison, shown in Table 3, with adjustments for bit size and for differences in starting depth in all cases. As shown, No. 7 Cheramie had an elapsed-time

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drilling rate during the last 350 ft. of 0.67 ft. per minute. The best time made at any of the rotary wells was 0.50 ft. per minute, in No. 5 Cheramie.

TABLE 3—COMPARATIVE DRILLING RATES OF GOLDEN MEADOW WELLS

Well—	Drilling time, hrs.*	Feet per minute†
Turbodrill:		
No. 7 B.&D. Cheramie	26	0.67
Rotary:		
No. 1 Theriot	38	0.40
No. 5 B.&D. Cheramie	40	0.50
No. 4 B.&D. Cheramie	80	0.25
No. 2 Authement	144	0.27
No. 1 Dufrene	192	

*From below conductor pipe to 3,248 ft.
†Elapsed time drilling rate for last 350 ft.

For drilling No. 7 Cheramie a heavy steam rig was used with four 125-hp. gas-fired boilers supplying steam at 350 psi. The slush pumps used were one 16¼ by 6 by 20 in., and one 15 by 5½ by 20 in., running in parallel at an average speed of 40 s.p.m. and delivering an estimated average mud volume of 600 g.p.m. Floor gage pressure was 750 psi. with the tool at the surface and 1,000 psi. with the tool at final depth of 3,248 ft.

Drill pipe used was 700 ft. of 6⅝-in. and the remainder 5 9/16 in. A conventional 13-in., long-toothed tricone rock bit with three ¾-in. and one ⅝-in. nozzles was made up on the 2-ft. drilling sub attached to the Turbodrill drive shaft. No drill collars were used. The 700 ft. of 6⅝-in. drill pipe was run on top of the tool with the remainder of the string being 5 9/16-in.

Two shale shakers and three mud tanks were used. The drilling mud, conditioned with Aquagel, caustic, and quebracho, had an initial weight of 8.8 lb. per gal. Its final weight was 9.8 lb., with a viscosity of 38 seconds. Average sand content of the mud was 6.5 per cent at the shale shaker and 4 per cent at the mud-pump suction inlet. The rig was equipped with bottom-hole weight indicator and a Geolograph. Electric, photoclinometer, and caliper surveys were run upon conclusion of turbine drilling. The logs obtained from these surveys will be discussed later.

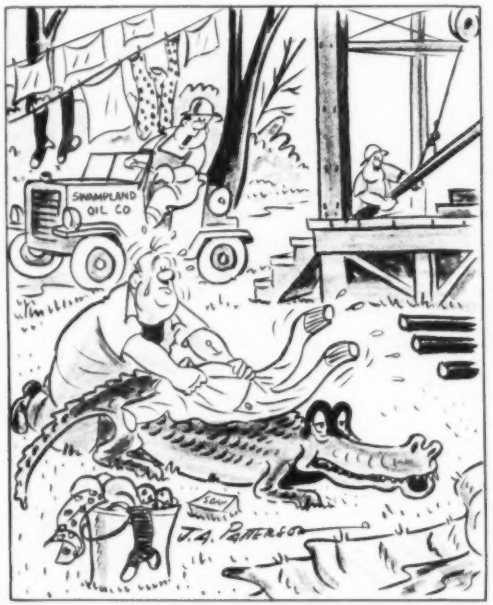
The rotary table was turned at an average speed of 15 r.p.m. to safeguard against sticking the drill pipe, but for considerable periods it was not turned at all. There was no indication of sticking at any time. Mud returns were excellent throughout, and circulation was not lost at any time. The average annular velocity was calculated to be 108 ft. per minute.

Weight carried on the bit ranged from 0 to 10,000 lb., with an estimated average of 3,000 lb. Drill pipe was entirely in tension at all times during the run—average neutral point was approximately 15 ft. above the bit. The calculated average bit speed was 400 r.p.m., ranging from 150 to 500 r.p.m. It is estimated that the bit made 450,000 revolutions in drilling the 2,006 ft. of hole. The turbine delivered a calculated 125 hp. to the bit, or 40 per cent of its rated maximum potential of 312 hp.

After the run under these conditions, the bit was in excellent condition with all teeth sharp, bearings sound, cones tight, and fluid nozzles undamaged. The bit appeared to be good for another 2,000 to 3,000 ft. of Turbodrill digging through similar formations. Life of a bit in drilling through these same formations with a conventional rotary is usually somewhat less than 2,000 ft.

The caliper log of No. 7 Cheramie (see Fig. 2) reveals the entire Turbodrilled section to be in full gage and of remarkably uniform diameter practically throughout. In fact, there is little question it is the truest-gage hole ever drilled on the Gulf Coast. Maximum diameter of the hole, drilled with a 13-in. bit, was 15 in. and the average diameter was 13 in. There were no washouts in the section, and no difference in hole gage through the sand and shale sections. The 9⅝-in. midstring casing was run in without difficulty and the cement job (1,500 sacks) was excellent, with immediate return of cement slurry when the plug was pumped down.

The photoclinometer log, Fig. 4, shows a maximum deviation for any



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200-ft. section to be 3°, and an overall deviation of 1½° over the Turbodrilled section. The drift was all in one direction, the bit apparently having gone down dip.

Turbine drilling was terminated at 3,248 ft. total depth, where 9⅝-in. casing was set. It was determined that excessive fluid leakage around the drive-shaft sleeve bearing through the lower bushing was robbing the bit nozzles of fluid volume and pressure. The penetration rate for the final 20 ft. of hole, through a sand section, fell to 4 ft. per minute. This compared with 10 ft. per minute through other similar higher sand sections where the bit was receiving full fluid volume with an estimated pressure drop of 200 psi. across the bit nozzles.

The three drillers who operated the rig throughout the Turbodrill run, L. P. Pettit, J. W. Smith, and R. M. Ogburn, and their crews had no previous experience with turbine drilling but had very little difficulty learning the technique. It is believed, however, that with drillers and crews thoroughly experienced in turbine drilling an even higher rate of penetration could be achieved. Jake Haas, general superintendent of Spartan, was in charge of the test. Assisting him were George P. Wagner, Edco designing and consulting engineer; W. E. Bagley, Spartan tool pusher; and Roy Wesson, Spartan production engineer.

The Golden Meadow operation is of special interest because it is the first time a direct comparison, at the same depth in offsetting wells, could be made between turbine and rotary drilling rates. The operation also proved that exceptionally true-gage holes can be drilled with the Turbodrill, resulting in more accurate electrical logs and making possible better cement jobs. Still another advantage of the true-gage hole is the higher and more uniform rates of fluid flow up the hole.

Turbine drilling, as the test bears out, holds great promise as a general substitute for or complement to conventional rotary drilling. Experience to date has indicated it can drill a faster and straighter hole with less wear on the drill pipe and rig. Since turbine drilling is fully interchangeable with rotary drilling, the fact that it is not adaptable to routine coring operations is of no special consequence.

Acknowledgment

Data presented in the above discussion of the Edco Turbodrill's performance at Golden Meadow were supplied by Critchell Parsons, president and general manager of Engineering Development Co., Dallas. Grady H. Vaughn, Dallas, is chairman of the board of Edco, and G. H. Vaughn, Jr., is vice president. Appreciation is expressed by the author for their permission to publish the results of the operation.

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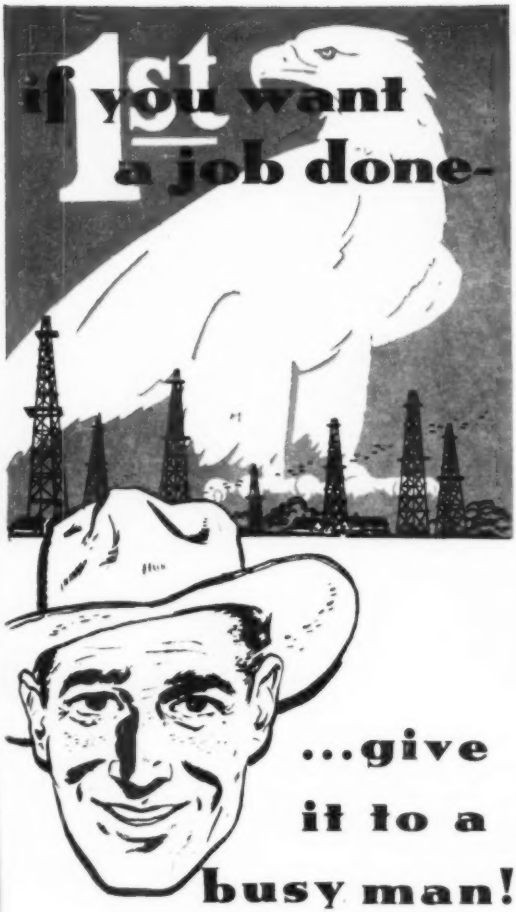

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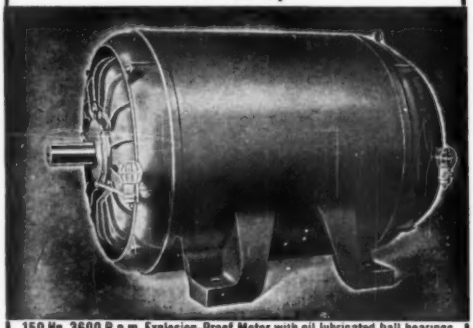

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QUESTIONS on TECHNOLOGY

by W. L. Nelson
Consulting Engineer

Heating Value and Composition of B.-B. Cut

In making computations of the heat of reaction in catalytic cracking, what values of the heating value of B.-B. cut and of dry gas should be used?—C. R. N.

In the computation of heats of reaction, heating values are vitally important and except for yield data, are the most important information.

The heating value of B.-B. cut is, of course, a function of its composition. Nevertheless, the composition of the B.-B. cut produced by catalytic cracking process is fairly uniform. The heating values (B.t.u. per pound, gross) of the several constituents of B.-B. cut are as follows (U. S. Bureau of Standards, Circular C-461):

Isobutene	20,716
1-Butene	20,833
2-Butene	20,760
Isobutane	21,242
Butane	21,293

Thus, little variation is possible, and if an average value of 21,140 (see below) is used, the maximum percentage of errors involved would be only 0.72 and 2.0.

Tables 1 and 2 show the compositions and heating values of several B.-B. cuts (or butane hydrocarbon mixtures in gases). The average heating value of the fluid process B.-B. cuts is about 21,069 B.t.u. per pound; from the Houdry process about 21,186; and from the T.C.C. process 21,101. However, only a small amount of data were available and hence it is doubtful if the several processes produce such different gases. The average for all of the data given in the two tables is about 21,140 B.t.u. per pound. The lowest value reported (20,981) is only 0.75 per cent lower than the average and the highest value (21,233) only 0.44 per cent above the average.

Note—Next week's issue will present the heating value of gases.

References

1. Grote and Olsen, Pilot Plant Evaluation of Fluid Cracking Catalysts, Pet. Refiner, Nov. 1947, p. 104.

2. Thomas et al, Cracking with Catalysts, The Oil and Gas Journal, Nov. 11, 1943, p. 131.

3. Ardern, Newton and Barcus, Catalytic Cracking of Cuts from Coastal Crude, Ind. Eng. Chem., 37, 546 (1945).

4. Dart and Oblad, Heat of Cracking and Regeneration in Catalytic Cracking, Chem. Eng. Progress, 45, 110 (1949).

TABLE 1—COMPOSITIONS AND GROSS HEATING VALUES OF SEVERAL B.-B. CUTS (FLUID)

	Percentage (liquid volume per cent) composition											
Hydrocarbons—	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Isobutene	8	7	8	10	14	14	11	6	17	22	7	3
1-Butene	10	5	11	11	10	15	11	6	17	22	7	3
2-Butene	17	29	22	24	23	6	7	7	8	11	14	11
Isobutane	52	47	47	44	42	55	61	71	48	35	62	73
Butane	13	12	12	11	11	10	10	10	10	10	10	10
Heating value, B.t.u. per lb.	21,076	21,042	21,047	21,026	21,014	21,077	21,104	21,152	21,042	20,981	21,107	21,161
Reference	(1)	(1)	(1)	(1)	(1)	(2)	(2)	(2)	(2)	(2)	(2)	(2)

Injection of Antidetonant To Gasoline Engine

We hear of a substance that can be added to gasoline that makes it work much better. It is something you can buy at filling stations. Can you direct me to this material?—F. C. P.

You probably have heard of the use of blends of alcohol and tetraethyl lead fluid as an auxiliary fuel which can be injected into the engine at moments of great loading (mainly slow-speed operation). This type of operation recently attracted much attention through sale by Thompson Vita-Meter Corp. *(Van Hartlesveldt, C. H., Automatic Octane Boosters for Engines, The Oil and Gas Journal, March 25, 1948, page 103)* of an antidetonant liquid and a special carburetor or attachment for its use. The use of such material was completely studied by Standard Oil Co. of Ohio (Potter, R. I., Use of Antidetonant Injection . . ., Petroleum Refiner, September 1948, page 125) in a special high-compression engine necessary for full utilization of the properties of such an octane-booster material. Results of Standard Oil tests are indicated in Table 1 (Potter, R. I.) but the article should be consulted for complete understanding of the usefulness of the injection agent.

Obviously, a dual-fuel or dual-injection system is required and this is a major difficulty. Such systems have been proposed for many decades.

TABLE 1—RESULTS WITH ANTIDETONANT INJECTION FOR ONE ENGINE

	Engines	
	Standard	High compression
Cross country*		
Miles per gallon	19.5	22.2
Increase in mileage per cent		13.7
Antidetonant used based on gasoline, per cent		2.9
Miles gained per gallon antidetonant		771
City trips		
Miles per gallon	15.9	19.1
Increase in mileage per cent		20.1
Antidetonant used based on gasoline, per cent		8.8
Miles gained per gallon antidetonant		220

*Including some city driving and hilly terrain.

TABLE 2—COMPOSITIONS AND GROSS HEATING VALUES OF SEVERAL HOUDRY AND T.C.C. B.-B. CUTS

	Percentage (weight) composition*															
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Isobutene	1.0	2.6	1.3	0.8	2.1	4.0	1.2	2.1	4.0	15.7	13.8	10.9	10.9	4.7	15.1	17.5
1-Butene	}									6.4	5.6	4.4	4.5	1.9	6.2	7.1
2-Butene	10.6	20.5	3.2	6.2	15.5	20.8	3.1	9.0	19.4	16.9	15.1	11.8	11.8	5.1	16.4	19.0
Isobutane	69.2	64.1	76.5	73.6	68.0	62.3	75.5	72.2	62.9	49.2	53.7	59.5	62.1	73.9	52.5	42.8
Butane	19.2	12.8	19.0	19.4	14.4	12.9	20.2	16.7	13.7	11.8	11.8	13.4	10.7	14.4	9.8	13.6
per lb.	21,200	21,145	21,231	21,221	21,170	21,136	21,233	21,200	21,142	21,098	21,080	21,117	21,116	21,192	21,064	21,038
Reference	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(4)	(4)	(4)	(4)	(4)	(4)	(4)
Process	(†)	(†)	(†)	(†)	(†)	(†)	(†)	(†)	(†)	(‡)	(‡)	(‡)	(‡)	(‡)	(‡)	(‡)

*Computed from complete gas compositions. †Houdry. ‡T.C.C.

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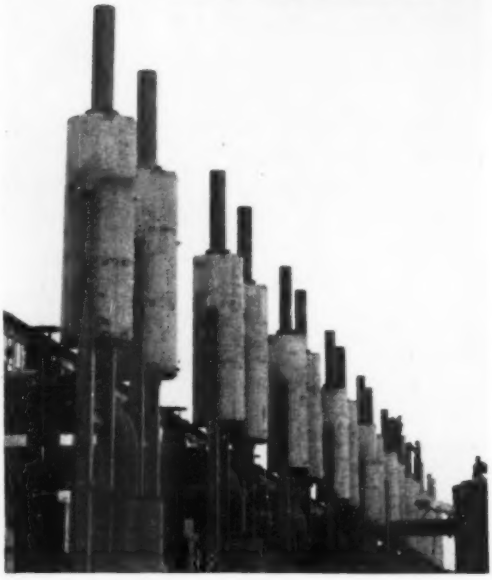

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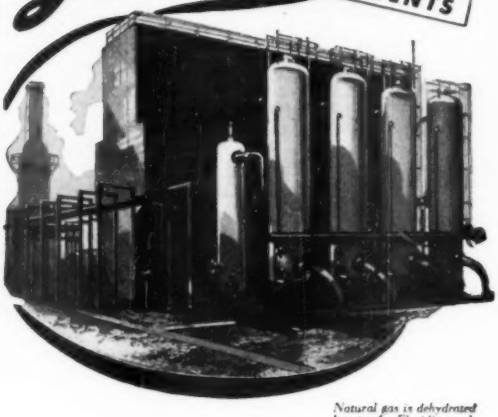

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TENTATIVE SCHEDULE OF TOPICS

No. 44—Aug. 18—Pipe-Line Construction
No. 45—Aug. 25—Valves
No. 46—Sept. 1—Fittings and Flanges
No. 47—Sept. 8—Chemical Equipment 2
No. 48—Sept. 15—Piping
No. 49—Sept. 22—Vacuum Equipment
No. 50—Sept. 29—Coil-in-Box Equipment
No. 51—Oct. 6—Chemical Equipment 3
No. 52—Oct. 13—Excavation, Concrete, and Foundations
No. 53—Oct. 20—Road Building
No. 54—Oct. 27—Fire Protection

TABLE 1—APPROXIMATE COST (1946) OF BAROMETRIC CONDENSERS[1]

Capacity: Nominal dia. (in.)	Capacity: Maximum H_2O rate (g.p.m.)	Dollars each: Steel	Dollars each: C.I.	Dollars each: Rubber-lined steel
10	40		250	
20	210	450	630	940
30	600	850	1,100	1,500
40	1,150	1,250	1,650	2,050
50	1,830	1,900	2,350	2,900
60	2,700	2,700	3,150	3,950
70	3,750	3,600	4,150	
80	5,000	4,800	5,300	

TABLE 2—APPROXIMATE* COST (1946)† OF TWO-STAGE STEAM-JET EJECTORS‡ WITH BAROMETRIC INTERCONDENSER,‡ DOLLARS EACH

Capacity, lb. per hr. 70° F. air	100 mm.	75 mm.	50 mm.	25 mm.	20 mm.	10 mm.
10				420	475	
20			350	505	570	705
30			435	575	640	780
40		440	500	630	700	840
50	450	480	560	675	755	890
60	485	515	610	710	790	
80	540	575	690	790	870	
100	575		765			
120			830			

*Questionable because data were not extensive. †Converted from March 1949 costs to 1946 costs by a factor estimated as 1.50. ‡Steam consumption (lb. per lb. air) ranges from about 4 at 100 mm. pressure to about 11 at 20 mm. With no intercondenser the steam consumption is 1.5-2.0 times more but the cost of the ejector is only 88.5 per cent.

TABLE 3—APPROXIMATE* COST (1946)† OF VACUUM PUMPS,‡ DOLLARS EACH

Capacity, lb. per hr. 70° F. air	100 mm.	75 mm.	50 mm.	25 mm.	20 mm.	10 mm.
10				1,150	1,420	2,000
20				1,670	1,850	2,550
30			1,150	1,900	2,200	
40		1,100	1,400	2,150	2,500	
50		1,280	1,600	2,420	2,750	
60	1,150	1,430	1,800	2,650		
80	1,380	1,690	2,120			
100	1,540		2,420			
120			2,700			

*Questionable because data are not extensive. †Converted from March 1949 costs by a factor estimated as 1.30. ‡Complete with motors and drives but no starter. (a) Single-stage reciprocating class ER, 10 by 5-in., 180 cu. ft. per minute, 400-r.p.m. pump, 7.5-hp. (b) Single-stage water-sealed rotary, size H4, 1,750-r.p.m. pump, 15-hp. motor. (c) Two-stage water-sealed rotary, size TS12 and 12S, 875-r.p.m. pump, 10-hp. motor. (d) Two-stage reciprocating class ER, 14 by 5-in., 178 cu. ft. per minute, 400-r.p.m., 10-hp. motor. (e) Oil-sealed rotary plunger, 486 cu. ft. per minute, 350-r.p.m. pump, 25-hp. motor. (f) Oil-sealed sliding-blade rotary, size 375, class W, 430 cu. ft. per minute, 200-r.p.m. pump, 20-hp. motor.

If electricity is available at 1 cent per kilowatt the cost of operation of some of the pumps is less than the cost of steam for ejectors, but the larger maintenance cost of the pump usually makes their operating cost larger than the cost of ejectors.

References

1. Jackson, D. H., Ejectors and Condensers, Chem. Eng., May 1947, p. 123.

2. Stinson, L. S., Comparative Costs of Mechanical Vacuum Pump and Steam Jet Ejectors, summer 1949 issue Powerfax of Elliott Co., Jeannette, Pa.

No. 49 in a series by W. L. Nelson, professor of petroleum refinery engineering, University of Tulsa

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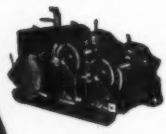

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REFINING

Sawyer Questions Synthetic-Rubber Future

WASHINGTON.—United States consumption of rubber this year is expected to be 1,010,000 long tons, about 6 per cent under 1948 but 71 per cent above 1939, but the Department of Commerce warned last week that with average business conditions future consumption of new rubber material will range only between 900,000 and 1,000,000 tons a year.

In his first annual report as administrator of the rubber program enacted by Congress last year, Secretary Charles Sawyer reported that the rubber industry in 1948 consumed 627,000 tons of natural rubber and 442,000 tons of synthetic of which 166,000 tons was used voluntarily over and above the amount required to be used in the manufacture of tires, tubes and certain other articles. Voluntary consumption of synthetic in tires, however, was small because of the ability of manufacturers to get the grade of natural rubber they use at a price considerably below the 18.5 cents per pound of general-purpose synthetic.

Sawyer expressed some doubt as to the future of synthetic rubber, expressing the view that if world production of natural increases or demand for new rubber decreases to such extent that the tonnage of synthetic necessary to balance supply with demand falls below the minimum of 221,667 tons specified in the Rubber Act continuing legislation may be required in order to assure national security.

"Due to political and social unrest in the natural rubber-producing areas of the Far East, estimates of future production and of potential capacity must remain uncertain," Sawyer said in reviewing the current situation. "It is generally accepted that current Malayan annual production of 700,000 long tons of natural rubber is close to potential capacity. On the other hand, conditions in Indonesia and Indochina especially have prevented the recovery of production to anywhere near potential capacity. Their capacities are generally judged to be in excess of 800,000 and 80,000 long tons respectively. Recent developments in China proper may indirectly influence the future supplies of natural rubber from the Far East.

"If full production of natural rubber were possible in the future, a tentative world-wide annual total tonnage of 2,125,000 long tons is conceivable.

"If currently projected world demand for new rubber material is sustained, any deficits that may appear between such demand figure and the supply of natural rubber are capable of being largely met by production of synthetic rubbers and reclaimed rubber. On the other hand, world production of natural rubber might increase sufficiently or world demand for new rubber decrease to such an extent that the tonnage of synthetic rubbers necessary to balance supply with demand would be less than the minimum of 221,667 long tons specified in the Rubber Act of 1948."

Work is Started on New Sohio Catalyst Change

Work has started on a catalyst change at Standard Oil Co. (Ohio's) Houdry unit at the No. 1 refinery in Cleveland, according to T. Ellwood Webster, president, Catalytic Construction Co., Philadelphia.

The work is being performed on a firm-bid basis and will be done on three cases at a time at the nine-case unit.

The plant has Type C-17 cases with the original tube pattern. The catalyst change will be completed in 9 weeks.

This operation is the third Houdry case turnaround Catalytic Construction Co. has performed for Sohio in Cleveland.

Synthetic-Catalysts Output To Increase at Ohio Plant

Greatly increased production of fluid-type synthetic-gel catalysts for the petroleum industry will result from improved manufacturing techniques and expansion of Cincinnati manufacturing facilities of Davison Chemical Corp., according to reports.

The company borrowed $1,000,000 from Metropolitan Life Insurance Co. earlier in the year, and most of the money is being used in expanding the Cincinnati catalyst plant.

Davison in 1942 constructed its first commercial catalyst plant in Baltimore to produce cracking fluids needed in processing of high-octane aviation gasoline. The plant, at Curtis Bay, had a capacity of 15 tons daily; later elimination of bottlenecks and a small capital outlay for improved equipment brought that figure up sharply.

The company's Cincinnati plant, formerly operated by Diakel Corp., and bought by Davison from War Assets Administration in 1947, had a capacity of 30 tons daily at that time. Introduction in Cincinnati of improved techniques worked out at the Curtis Bay plant and the current expansion program is expected to bring combined capacity of the two installations to approximately three times the original 45 tons daily, by the end of this year.

A company spokesman said that new petroleum refineries being built throughout the country, especially on the Atlantic Coast, call mainly for the fluid-type synthetic catalyst.

Imperial's Edmonton, Alta. Refinery Increases Output

TORONTO.—In a statement made at Calgary, H. H. Hewetson, president of Imperial Oil, Ltd., disclosed that the new Imperial refinery at Edmonton, which started operations a year ago at 4,500 bbl. daily, is now handling 21,500 bbl. of Leduc crude daily, making it the largest plant in Canada west of Sarnia.

Imperial has also repaired its Regina plant and stepped up capacity to around 17,000 bbl. daily. The Calgary East plant is handling about 10,000 bbl. a day, and a plant recently acquired at Winnipeg has been stepped up to around 4,500 bbl.

Some plant construction is under way at Edmonton, but Imperial's own construction plans at Winnipeg have been deferred to permit concentration of all available resources on the $90,000,000 crude-oil pipe line from Edmonton to Superior, Wis. The pipe line, Hewetson indicated, will be a common carrier.

Jefferson Chemical Plant Still Shut Down by Strike

The Port Neches, Tex., plant of Jefferson Chemical Co., Inc., manufacturers of ethylene glycol, ethylene oxide, and chlorinated hydrocarbons, remained shut down last week by a strike of production employes called by Oil Workers International Union (C.I.O.).

The company and the union had been negotiating their initial contract for several weeks and a last-minute attempt was made to settle their differences with the aid of a federal mediation-service conciliator. When this failed to bring a settlement, the O.W.I.U. representing the production employes called the strike. Meanwhile, the company announced plans to proceed with negotiations for its first contract with the International Association of Machinists and Port Arthur Building and Trades Council (A.F.L.) who represent the maintenance employes.

The company has offered the production employes a 15-cent-per-hour increase, but the offer was refused. The union is holding out for 25 to 45 cents per hour. Among the other issues involved in the strike are the right of the company to determine the size of the plant working forces and whether the company shall be required to negotiate upon union demand for reduction of the work week from 40 to 36 hours, subject to threat of strike if not settled by negotiation.

U.O.P. to Build Plant in Shreveport for Specialties

Universal Oil Products Co., Chicago, has purchased a tract of land in excess of 600 acres between Shreveport and Mooringsport on the Kansas City Southern Railroad, where Universal plans to construct a plant for the manufacture of specialty products, David W. Harris, president, announced.

In his statement, Harris emphasized that actual construction of the manufacturing plant will depend on one or two major factors on which decisions are pending, but if those decisions are favorable then his company will start construction on the first unit as rapidly as possible.

Harris also pointed out that a plant such as Universal plans will bring a new industry to the industrial area of Shreveport, as well as to the state of Louisiana, and that if Universal's plans mature, it will ultimately employ a sizable number of both technical and nontechnical personnel.

Ohio Oil to Formally Open New Refinery October 5

Ohio Oil Co. will formally open its modernized and greatly expanded refinery at Robinson, Ill., on October 5, J. C. Donnell, II, president, announced. Open house will be held for representatives of the press and leaders in the industry. A conducted tour of the new refinery will be given.

Houston Plant Now Making "Cold" Synthetic Rubber

HOUSTON.—Production of the new "cold" synthetic rubber has started at the Government-owned Goodyear Synthetic Rubber Corp. plant here.

The Government authorized conversion of 24 of the plant's 48 reactors and installation of refrigeration equipment. Total cost of the project was about $675,000. Half of the 60-ton annual capacity of the plant will continue to make GR-S rubber.

The Houston plant, which was completed in the fall of 1943, had produced more than 600,000,000 lb. of GR-S rubber before the conversion began.

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NATURAL GAS

Two Companies File Joint Bid for Line Construction

Central New York Power Corp. and New York Power & Light Corp. have filed a joint application with Federal Power Commission seeking authorization to construct and operate pipe-line facilities which would carry approximately 4,100,00 cu. ft. of natural gas per day for distribution in Oswego, Onondago, Madison, Oneida, and Herkimer counties, New York.

Estimated over-all capital cost of the proposed project is $972,000, of which $965,500 will be expended by Central and the remaining $6,500 by New York Power. Both companies are wholly owned subsidiaries of Niagara Hudson Power Corp.

Central is proposing to construct a 16-mile pipe line to receive the additional 4,100,000 cu. ft. of gas from its present supplier, New York State Natural Gas Corp. The line would connect with New York State's system on the Otisco-Onondago town line in New York and extend north and east to a connection with Central's existing system near Syracuse.

The application says the natural gas transported over the proposed line would be used for distribution in that portion of Central's Utica division lying between its Syracuse-Oswego division and the Oneida district of New York Power; (resale to New York Power's Oneida district in Oneida and Madison counties); and a reforming and enriching agent in Central's gas-manufacturing operations in its Utica division, comprised of all or parts of Madison, Oneida, and Herkimer counties.

Central's Syracuse-Oswego division is now served with natural gas, while manufactured gas is distributed in its Utica division and New York Power's Oneida district.

FPC Files Portion of Colorado Interstate Tariff

Federal Power Commission Presiding Examiner Marvin Farrington has issued an initial decision ordering one volume of the proposed natural-gas tariff filed by Colorado Interstate Gas Co. accepted for filing, but ordering the company to refile a second volume which involves Colorado Interstate's sale of gas to Natural Gas Pipeline Co. of America. Both volumes of the tariff previously had been suspended by the commission.

The examiner's decision is subject to review by FPC, either on appeal by parties to the proceeding within 20 days, or on its own motion within 10 days thereafter.

Volume 1 of Colorado Interstate's tariff contains new rate schedules for the sale of gas to a number of distributors in Colorado and to Colorado-Wyoming Gas Co. The present rate schedules have been applied to all gas deliveries to the customers, including gas ultimately used in the customers' steam and electric generating plants. The presiding examiner held that the rate schedules in Volume 1 are inapplicable to gas consumed in such plants, and therefore ruled that such volumes of gas should be deducted from the total volumes sold to purchasing distributors.

However, the examiner found that Volume 2, by not including a 1931 contract providing for the sale of gas by Colorado Interstate to Natural Gas Pipeline Co. of America, constitutes changes in terms and conditions of service which are "unjust, unreasonable and unduly discriminatory. . ." The examiner ordered Colorado Interstate to restate in Volume 2 all presently existing effective provisions of the 1931 contract, and to refile the volume for commission approval.

The customers of Colorado Interstate which would be affected by the changes under Volume 1 of the tariff include Canon Gas Service Co., of Canon City, Colo.; Colorado Springs Department of Public Utilities; Colorado-Wyoming Gas Co., of Denver; Public Service Co. of Colorado; and Pueblo Gas & Fuel Co. of Pueblo. (Related story on Colorado Interstate appears in the pipe-line news section of this issue.)

United Gas Pipe Line Co. To Build Research Plant

United Gas Pipe Line Co. will construct a new $325,000 research laboratory in Shreveport, which will be used for study of pipe-line operational problems.

Construction is to begin within 1 month, and the laboratory is scheduled for completion within 6 months.

New York State Natural Seeking to Store Gas

Federal Power Commission has been asked to authorize New York State Natural Gas Co. to operate its Sharon storage pool in Potter County, Pennsylvania, and to permit the construction and operation of facilities for injection and withdrawal of gas.

The company also wants to install appurtenant compressor and pipe facilities. The entire project is estimated to cost $611,861.

Panhandle Rate-Suspension Case Postponed by FPC

Federal Power Commission has postponed until September 26 the hearing previously scheduled to commence September 19 in Washington, D. C., in the proceeding involving FPC's suspension of Panhandle Eastern Pipe Line Co.'s proposed natural-gas tariff and statements.

The Public Service Commission of Indiana, an intervener in the Panhandle proceeding, requested the postponement because hearings now in progress in a proceeding before that commission will not be completed by September 19.

Natural Gasoline

New Plant Being Built in Texas' Santa Rosa Field

J. F. Pritchard & Co., Kansas City, Mo., is constructing a 30,000,000-cu. ft. natural-gasoline plant in the Santa Rosa field of Pecos County, Texas, for Slick-Urschel Oil Co., and Texas Natural Gasoline Corp., Tulsa. The latter company was said to have an operating agreement. Slick-Urschel owns production in the Santa Rosa field.

Completion of the gas-treating units is scheduled for October 1, and butane and casing-head gasoline facilities are scheduled for completion December 1. El Paso Natural Gas Co. has contracted to start taking natural gas October 1.

F. H. Goodwin, formerly of Abilene, Tex., will be superintendent of the processing plant. Goodwin said a minimum of 17 men would be employed.

Eight houses already have been built near the plant site, which occupies 40 acres. The houses were fabricated in a Dallas plant and assembled at the site. Seven of the houses are two-bedroom units and the eighth is a three-bedroom unit.

Richfield Oil to Build Natural-Gasoline Plant

Work will start immediately on Richfield Oil Corp.'s $4,500,000 separation plant to extract natural gasoline from wet gas at the new South Cuyama oil field in Santa Barbara County, California.

A smaller plant similar to the one to be constructed is nearing completion at Russell Ranch field in the upper Cuyama Valley, San Luis Obispo County.

Officials of Richfield said the Russell Ranch plant will cost in excess of $2,000,000.

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PIPE LINES

Pipe Lines, Railroads Should Cooperate—Burke

PIPE lines and railroads should stop fighting each other and join in a cooperative effort to find a solution for the nation's transportation ills or else both will be faced with the threat of nationalization, J. L. Burke, president of Stanolind Pipe Line Co., told the Trans-Missouri-Kansas Shippers Board, the Tulsa Traffic Club, and the Tulsa Chamber of Commerce at a joint meeting September 15.

Deploring the support from some railroad quarters for legislative proposals to impose further regulation on the pipe-line industry and particularly to vivisect it and divorce it from the interrelated processes of the oil industry, Burke said that the transportation industry as a whole cannot be bettered by one carrier seeking the imposition of burdensome regulation on another form.

The first step in the solution of the transportation problem, he said is for all carriers to join in an effort to abolish the outmoded and archaic forms of regulation and reduce controls to those definitely required to serve the general public interest of all.

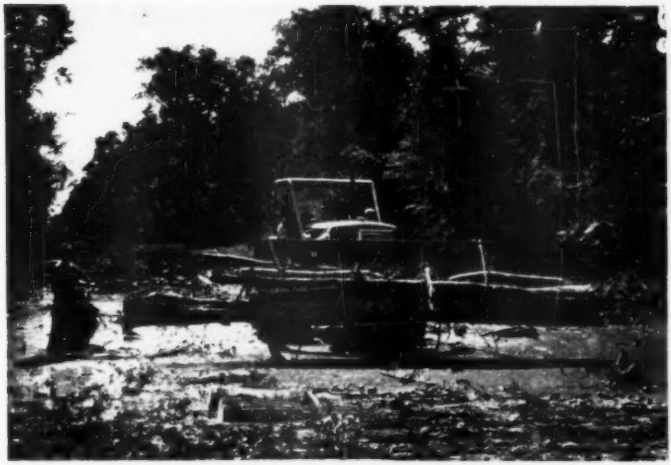
"The alternative is nationalization," he declared. "A trend toward this alleged panacea for all ills is rife in the world, and apparent even in this country. There is good reason for suspicion that those seeking nationalization here are aiming at the railroads as a starting ground. All transportation men should stand shoulder to shoulder to prevent nationalization of transportation."

Burke, who started life as a railroad man, said he could readily understand how railroads are unhappy to see large volumes of petroleum move by pipe lines instead of by rail, but he declared that without pipe lines the oil industry never could have developed to its present stage in which it furnishes an enormous tonnage of other traffic to the rails.

"The pipe line is not a competitor but a promoter of traffic for the railroads," he said. Pipe lines are common carriers in fact, he added, and currently they are delivering an average of 2 bbl. of crude oil to non-proprietary refineries for every 3 bbl. they deliver to the companies owning them.

12-In. Gas Line in Worland, Wyo., Area to Be Delayed

Lacking Federal Power Commission approval, Montana-Dakota Utilities Co. reported last week that it cannot start this fall on construction of a 330-mile, 12-in. natural-gas pipe



Bulldozer carrying logs down right-of-way in clean-up at Latex Construction Co.'s section in Southern Arkansas for Texas Gas Transmission Corp.'s line now under construction from Carthage, Tex., to Middletown, Ohio

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line from the Worland, Wyo., field into Montana.

An FPC hearing on the firm's application for a certificate of convenience and necessity began in Washington the latter part of August and recessed until October 17. Montana-Dakota said that the season would be so far advanced before conclusion of the hearing that construction would not be feasible.

"Tentative plans," a company statement read, "scheduled completion of the line in the fall of 1950. We had expected to complete construction of that part of the line which traverses the irrigated areas in northern Wyoming by late this fall, after crops had been harvested. It was also our plan to proceed with construction of the dehydration and compressor station this fall. Because of the delay in securing the certificate, no construction can be started this fall."

The company said its plan was, however, "to adhere as closely as possible to our original schedule so that Wyoming gas will be delivered into our Baker-Bowdoin system before the end of 1950."

The proposed 12-in. line would run 330 miles from Worland to a point in the Baker gas field, to connect with the firm's Baker-Bowdoin system.

Lebanon Base Prepared for Trans-Arabian Line Work

In preparing for the resumption of construction operations at the northern end of Trans-Arabian Pipe Line Co.'s 1,067-mile, 30-31-in. line from Abqaiq, Saudi Arabia, to Sidon, Lebanon, Williams Brothers Corp. has established headquarters in the French compound at Beirut, Lebanon. Several shiploads of equipment have arrived for laying pipe in the section contracted by Williams Brothers.

A. M. Garber is manager of operations for Williams Brothers. J. H. Burrought is assistant manager and T. A. Wainwright, office manager.

Arkansas Louisiana Gas to Build Pipe-Line Facilities

Federal Power Commission has authorized Arkansas Louisiana Gas Co., Shreveport, to construct and operate additional natural-gas facilities, including about 163 miles of 20-in. pipe line, in Texas, Arkansas, and Louisiana. Estimated cost of the construction is $7,618,500.

Under the authorization, the company will build a 72-mile line with a capacity of 200,000,000 cu. ft. of natural gas per day extending from Harrison County, Texas, to Columbia County, Arkansas, and approximately 90.8 miles of line between Columbia County and Perla, Ark. The latter line will have a daily delivery ca-

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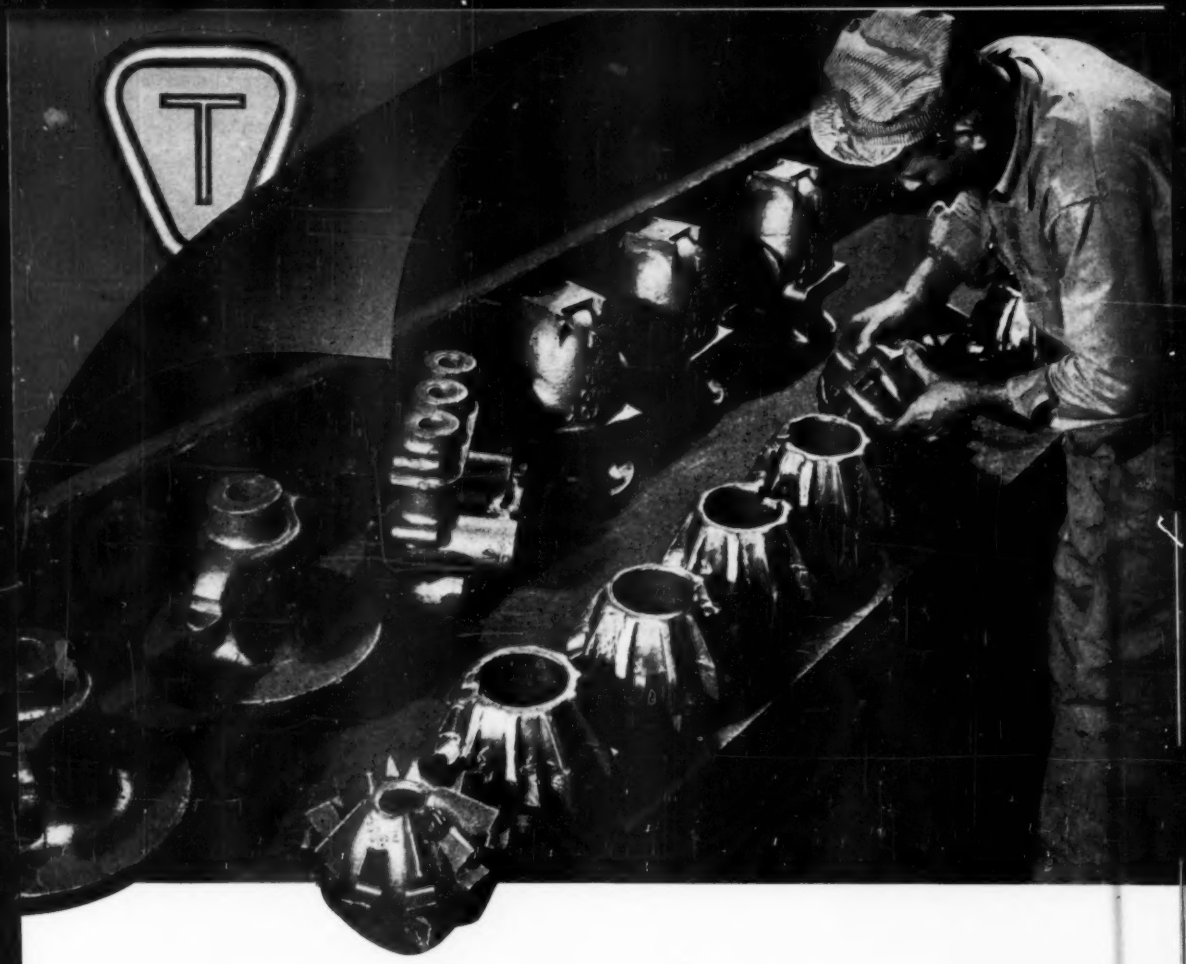

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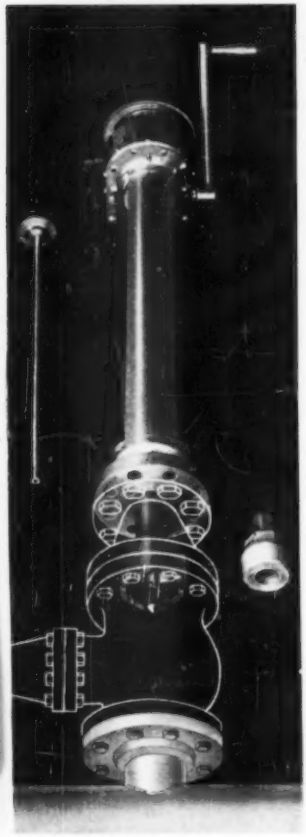

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pacity of 140,000,000 cu. ft., the company said.

The construction program will make natural-gas service available to additional domestic, commercial, and industrial consumers in Central Arkansas and will make possible increased deliveries to the company's existing customers, according to the application.

The company also received FPC authorization to abandon approximately 11.5 miles of pipe line in Louisiana and to discontinue service to 10 rural customers.

Three Proposals for Line Construction Consolidated

Federal Power Commission has consolidated the application filed by United Gas Pipe Line Co. with proceedings involving the applications of Atlantic Gulf Gas Co. and Southern Natural Gas Co. which were previously consolidated and on which hearing is now in progress.

United Gas is proposing to build 224 miles of pipe line designed to carry natural gas from several producing fields in southeastern Louisiana for delivery to Atlantic Gulf at the western terminus of that company's proposed Louisiana - South Carolina - Florida pipe - line project. United Gas Pipe Line and Atlantic Gulf both are subsidiaries of United Gas Corp. and have main offices in Shreveport.

Southern Natural, of Birmingham, the third company involved in the consolidated proceedings, is seeking FPC authorization to build a Mississippi-Georgia pipe line, with extensions in Georgia, Florida, and South Carolina. Southern Natural and Atlantic Gulf both propose to serve substantially the same areas in the South.

Texas Electric to Build Power Line in West Texas

DALLAS.—Texas Electric Service Co. will build a 66,000-volt electric transmission line from Colorado City to Snyder, Tex., to supplement present facilities serving Snyder and the rapidly growing Scurry County fields, according to J. B. Thomas, president of the company. The new line was scheduled for completion November 1.

The Colorado City pump station of the Basin Pipeline System also will be supplied by the new power line. The station is now nearing completion. Texas Electric has contracted to supply power to five pump stations on the pipe line. More than 20,000 hp. in electric motors will be installed in these stations to operate the pumps and other equipment.

Texas Electric's 40,000-kw. steam-electric generating station, now under construction, on Morgan Creek south-

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west of Colorado City, is scheduled for completion next June. The plant will utilize natural gas from West Texas oil fields.

Colorado Interstate Given Permit to Build New Line

Colorado Interstate Gas Co., Colorado Springs, has received Federal Power Commission authorization to construct additional facilities designed to increase the daily sales capacity of the company's natural-gas transmission system by 62,000,000 cu. ft. per day. Estimated cost of the project is $4,328,930.

The expansion program involves an increase to 181,000,000 cu. ft. in the daily capacity of the company's pipe line connecting the Hugoton field in Kansas and the City of Denver. The program includes construction of 38 miles of 20-in. main-line loop on the Hugoton pipe line in the vicinity of Denver; installation of three 1,200-hp. compressor units at the Lakin station at the Hugoton field; and construction of a new 8,400-hp. compressor station on the Hugoton pipe line near the town of Kit Carson.

Colorado Interstate's utility customers in Colorado include: Colorado Springs Department of Public Utilities, Public Service Co. of Colorado, The Pueblo Gas & Fuel Co., Canon Gas Service Co., Limon Natural Gas Co., and Colorado-Wyoming Gas Co. (See related story on Colorado Interstate's proposed tariff, on page 303 of this issue.)

Southern Natural, Atlantic Gulf Hearings to Reconvene

Federal Power Commission hearing on applications filed by Southern Natural Gas Co., Atlantic Gulf Gas Co., and United Gas Pipe Line Co. will reconvene in Savannah, Ga., following conclusion of the phase of the hearing scheduled to commence September 20 in Tallahassee, Fla.

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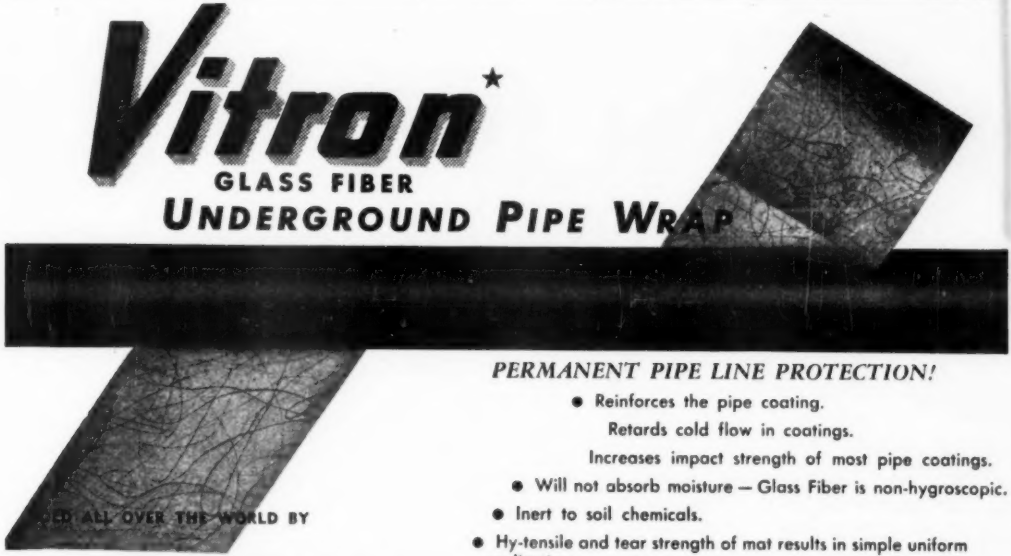

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Arrow Drilling Co. Hires Blevens as Representative

Arrow Drilling Co., Tulsa, has announced that S. M. Blevens, lately with C. W. Cotton Supply Co., Tulsa, has become associated with the organization as contact representative. Bevins started work in the oil fields as a roustabout when 19 years old, and in the intervening years has been a driller, scout, production superintendent, owner of his own drilling and production company, and equipment sales engineer. In the latter field, prior to going with the C. W. Cotton Supply Co., he was associated first with Jones & Laughlin, Inc., and then with Larkin Packer Co.

Former Employes to Run Santa Maria Drilling Co.

Santa Maria Drilling Co., Long Beach, Calif., has been reorganized with J. F. Husolf, formerly field superintendent, as president; Clinton A. Patrie, formerly tool pusher, vice president; and Kenneth J. Guido, formerly office manager, secretary-treasurer. E. R. Morris and E. J. Simonis, formerly president and secretary-treasurer, respectively, will remain temporarily with the company in advisory capacities. The company currently is operating three rigs.

ROTARY RIGS IN OPERATION*
(United States and Western Canada)

Area	Week ended 9-12-49	Change week ended 9-5-49	Change week ended 9-13-48
Gulf Coast	526	— 2	— 51
W. Tex.-N. M.	545	+18	— 52
Ark.-N. La.-E. Tex.	148	— 3	— 25
Oklahoma	224	— 9	— 83
Kansas	113	+ 6	— 21
Illinois-Eastern	116	0	— 18
Rocky Mountains	109	+ 4	— 65
Pacific Coast	153	—11	+ 20
Total United States	1,934	+ 3	—295
Western Canada	70	— 1	+ 18
Total	2,004	+ 2	—277

*Courtesy Hughes Tool Co.

Southeastern Drilling Co., Inc., Jackson, Miss., is starting a 11,250-ft. test for L. M. Lockhart at J-A U.S.A., 44-6n-2w, 5 miles south of Kirby, Franklin County, Mississippi.

R. C. Patton, Wichita, is drilling a second well for Barbara Oil Co. in the new pool opened by the latter company in Barber County, Kansas. The location, in 15-33-11, is a northeast offset to the discovery well, which found production in the Mis-

C. U. Perry, second from left, was the drilling contractor on the discovery well of the shallow oil pool recently opened on the Bryan Mound salt dome, southeast of Freeport, Brazoria County, Texas Gulf Coast. With him at the well site are, left to right: R. M. Murray, field foreman, and Carl Kearfott, geologist and engineer, Freeport Sulphur Co.; and John Johnson, Bay City, Tex., store manager, Wilson Supply Co. The well flowed initially at the rate of 55 bbl. of 34° A.P.I. oil daily from a sand at 1,388 ft.

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sissippi lime at 4,546-65 ft. The pool is 11 miles north of the Oklahoma line and 7 miles from nearest production.

Williams-Copeland, Inc., Tulsa, has been awarded contract by Beach Oil Co. for another well to be drilled on the south side of the Mercer pool in Creek County, Oklahoma. The well, 1 Bailey, NE NW NE 32-16n-8e, is projected to 3,900 ft. to check the Wilcox.

Loffland Brothers Co., Tulsa, has contracted to drill a Devonian test for Barnsdall Oil Co. and associates in the Time area, in LSD 5, 12-59-13w4th, 70 miles northeast of Edmonton, Alta., Canada.

Lohmann - Johnson Drilling Co., Evansville, Ind., is starting a rank wildcat test for Continental Oil Co. in Ford County, Kansas. Location of the test, 1 Crouse, 29-27-22, is 15 miles southeast of Dodge City and 25 miles northwest of the Excel pool, southwestern Kiowa County.

Kuykendall Drilling Co., St. Elmo, Ill., is the contractor for Frederick B. Cline on the latter's 1 Weil, 18-9n-9w, a Devonian test in the Marts area, Sullivan County, Indiana.

Dunbar Drilling Co., Salem, Ill., has the contract or another Devonian test to be drilled for L. G. Torkelson in the Terre Haute South pool, Vigo County, Indiana. Location is 1 Shoemaker, 10-11n-9w.

Fleet Drilling Co., Ada, Okla., is drilling Great Lakes Carbon Co. 1 Bridge, 24-14n-4e, southeast of Chandler, Lincoln County, Oklahoma.

Atlantic Oil Co., Los Angeles, has contracted with Termo Co. for the drilling of two additional wells in the Long Beach Harbor field, California. The new locations are LBHD D-10 and D-11. Rig is up for the first.

Standard-Fryer Drilling Co., Inc., Dallas, is drilling for Ted Weiner at 1 Floyd, Section 15, Block 37, T&P Survey, in the South Midland field, Midland County, Texas.

Moran Drilling Co., Wichita Falls, Tex., is rigging up for a deep test to be drilled for Tide Water Associated Oil Co. and Cities Service Oil Co. in Jackson County, southwestern Oklahoma. Location is for 1 Johnson, NE NE SE 19-3n-23w, 9 miles northeast of DeQueen. Contract calls for 8,500 ft.

Fred M. Manning, Inc., Denver, is the contractor for Western Prairie Exploration Co., Ltd., Canadian subsidiary of Woodley Petroleum Co., on a wildcat test the latter is starting near Endiang, 100 miles northeast of Calgary, Alta., Canada.

T. P. Pike Drilling Co., Los Angeles, has moved a rig from the Carrizo Plains field to the Blackwell's Corner field, Kern County, California, where it will drill a well for Universal Consolidated Oil Co.

C. O. O'Neal, Evansville, Ind., has contracted with Skelly Oil Co. to drill a well on the latter's J. I. Thomas Unit lease, 11-12n-16w, in the Logansport field, DeSoto Parish, Louisiana.

Hamilton Brothers Drilling Co., Wichita Falls, Tex., is drilling a 6,000-ft. wildcat test for S. D. Johnson and associates on the Avis Estate in the L. F. Rounds Survey, southeastern Wichita County, North Texas.

Kerr-McGee Oil Industries, Inc., Oklahoma City, is rigging up for a wildcat test (1 Evans) to be drilled for Carter Oil Co. in 5-2n-1w, 3 miles northeast of the Northeast Elmore pool, Garvin County, Oklahoma.

Buaas Drilling Co., Bakersfield, Calif., has the contract to drill F. C. Griggs 3 Norris in the Cuyama Valley field, Santa Barabara County, California.

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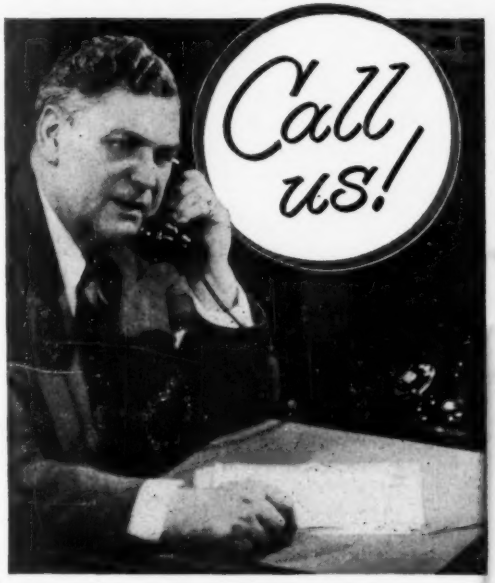

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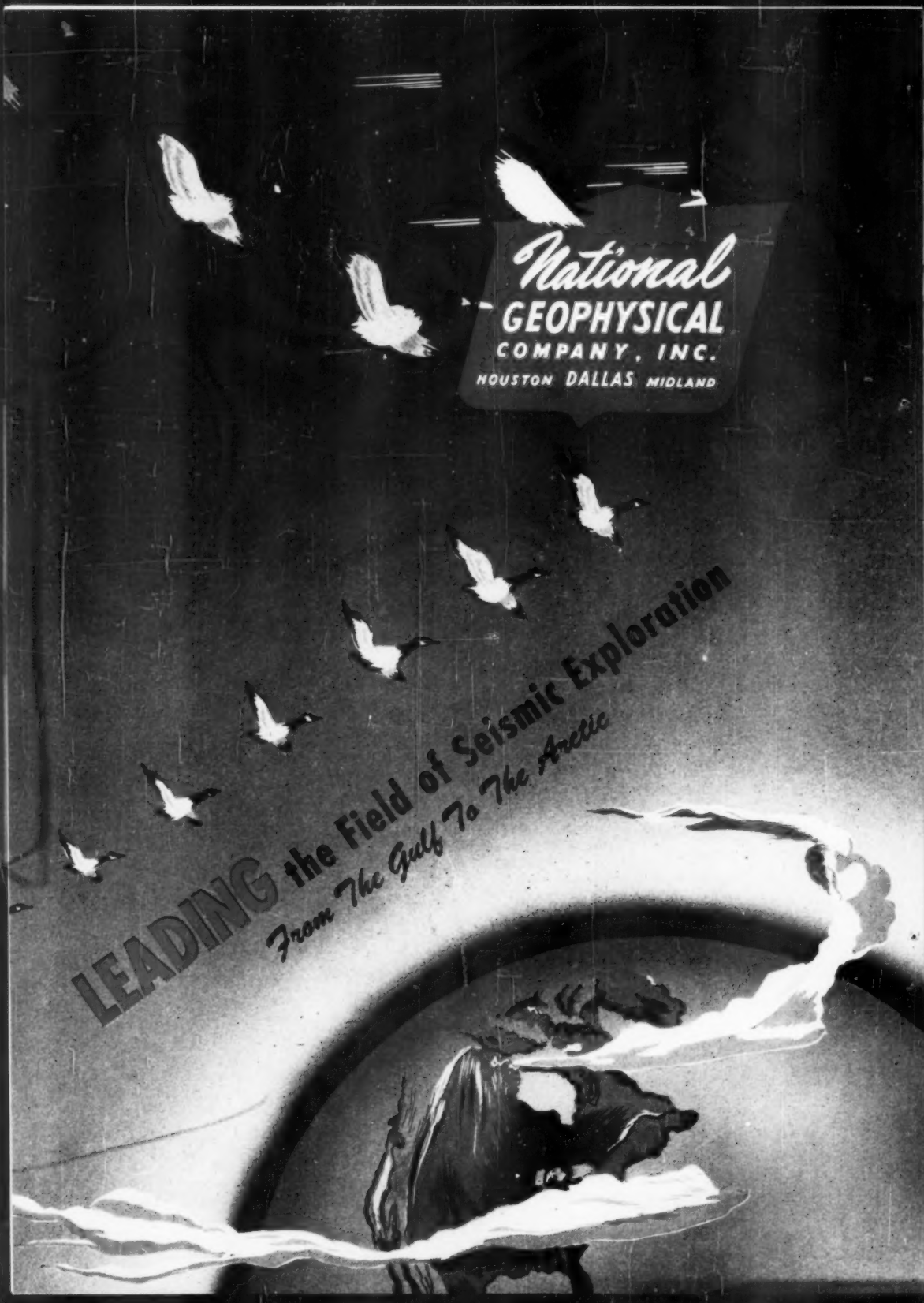
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What Lies Over The Horizon?

THE exploration branch of our American petroleum industry is the most efficient group of oil finders in the world. The record on that score is quite clear. Does that mean that our geologists, geophysicists, paleontologists, or other scientists are satisfied with present methods? The answer is a most emphatic NO!

The patent search, compilation, and abstract work of one of the major companies lists almost 900 patents issued in 1947 and 1948 which were of interest to the geologists and geophysicists. Of course a lot of these patents dealt with instrumentation, electronic devices, etc., often from some other industry's research. But let's take a look at just a few high spots.

In the field of new prospecting methods, there were 23 patents issued. There were eight patents under the heading "Electrical Prospecting;" five patents under "Electromagnetic Prospecting." So, in the currently less-active phases of geophysics we have 13 patents in the 2 years. How about geochemistry? Under the general heading of "Geochemical Prospecting," six patents were issued. That "Soil Analysis" is still far from dead is evidenced by four patents issued; and incidentally some were assigned to one of the major companies. So, the score is 10 patents for geochemical methods; 13 for geophysical methods of a type not used to any great extent at present.

In the general field of logging, the patents issued indicate a slightly feverish activity. There were 56 patents issued in the 2-year period. Alphabetically they are: "Acoustic Logging," 2; "Electric Logging," 19; "Electromagnetic Logging," 4; "Fluorescence Logging," 5; "Logging While Drilling," 2; "Magnetic Logging," 1; "Mud Logging," 6; "Photographic Logging," 1; "Radioactive Logging," 16. Currently, of course, electric and radioactive logging dominate the field. That steady, and perhaps large improvements are likely in these two methods is a pretty safe guess. They account for 35 of the 56 patents issued in the 2-year period, and this merely confirms their past history. Evidently there is to be no resting on the oars in these two fields.

On the other hand the fact that so much research work has been going on in other methods of logging is not too surprising. Drilling wildcat wells is expensive business, and of course the majority of them are dry holes. Every exploration man wants to extract the last possible ounce of information available from a wildcat, even if it is dry.

Among geologists this subject is so important that the presidential address of retiring A.A.P.G. President Paul Weaver at the St. Louis convention last March was devoted to this topic. *(The Oil and Gas Journal, March 17, 1949, page 102).* Then, too, geologists are "touchy" these days about the subject of oil pays that have been missed in the past.

It is all very well to talk about getting the last ounce of information out of every wildcat, and not passing up any oil or gas pays that fail to show up strongly. But management in many cases is already critical of the amount of time and expense involved in coring and drill-stem testing in many wildcats. So geologists would like to see an absolutely "foolproof" method of logging, which couldn't be misinterpreted, and would positively show the presence of any oil or gas worth drill-stem testing.

Reservoir engineers and production men would also like to have even more information about gas-oil and oil-water contacts, or whether there are sharp oil-water contacts present. It would make completion practices and workover jobs a lot simplier. It looks as though the scientists are working hard to develop logging methods that will be an improvement over what we now have, even though what we have is far superior to what was available only a few short years ago.

Charles J. Deegan.

HIGHLIGHTS OF WEEK'S DEVELOPMENTS

NORTH TEXAS.—Buz Morgan and Cook Drilling Co. 1 O'Neal, Ellenburger prospect in northeastern Parker County, was expected to increase its oil yield after a three-stage acid treatment. Gas pressure had increased from 100 psi. to 625 psi. on the tubing as the testing started. Mid-Continent Petroleum Corp. 3-A Boyd, S. H. Hazel Survey, Jack County, confirmed Ellenburger production at the company's third such strike with a flow of 115 bbl. of oil in 12 hours. Location is a northwest offset to the discovery well.

WEST TEXAS.—Hiawatha Oil & Gas Co. plans to test the Clear Fork section in its 7 Wilson, SE SE SW of Section 183, in the Diamond M field of Scurry County. In the Doss (Wolfcamp) field, Gaines County, Humble Oil & Refining Co. 5 Helen Cunningham prepared to complete in the Canyon lime. Drill-stem tests from 8,874-8,948 ft., total depth, indicated good commercial production.

SOUTH LOUISIANA.—A new pay sand has been opened in the Fordoche field, Pointe Coupee Parish, by The Texas Co. 3 J. O. Long, et al. Through perforations at 8,798-802 ft., the well flowed 155 bbl. of 38.5° gravity oil per day through a 9/64-in. choke. Total depth of the well is 9,600 ft.

ROCKY MOUNTAIN AREA.—Sinclair Oil & Gas Co. recovered oil in the upper Nugget sand and water in the lower Nugget at its Happy Springs wildcat, in Fremont County, Wyoming. Phillips Petroleum Co.'s third test at South Cole Creek, Converse County, Wyoming, made oil in a new-pay zone, the Dakota. The William Tomberlin completion at West Fiddler Creek, Weston County, Wyoming, flowing 132 bbl. per hour, has again attracted attention to that area of the eastern Powder River Basin play. Pitts-Colorado Oil Co. found water in Dakota at the Coles Dome, Moffat County, Colorado, wildcat and is going ahead for Morrison and Sundance.

N. CENTRAL TEXAS

Jack County Wildcat Flows Oil, Continues Test

WICHITA FALLS.—Mid-Continent Petroleum Corp. 1 T. E. Davis, J. J. Shelton Survey, just west of the Wise County line, in northeastern Jack County, flowed 45 bbl. of oil the first and second hours and 30.6 bbl. of oil the third hour, through 24/64-in. choke, after acidizing perforations in the upper Ellenburger from 6,702-45 ft. On 12/64-in. choke the well gaged 8.2 bbl. of oil during the fourth hour, and 13.1 bbl. of oil the fifth hour flowing through 16/64-in. choke, after which it died. Flowing tubing pressure during the last hour was 575 psi. Testing was to continue.

In southeastern Jack County, J. J. Lynn 1 L. A. Cranford was staked 330 ft. south and west of the southeast corner of the N. W. Walker Survey, but in the H. Ferguson Survey, 3½ miles south of Steed-Worsham Bend conglomerate field. Contract depth on the wildcat was 4,800 ft.

In east-central Jack County, C. G. Glasscock and Pontiac Refining Co. 3 Morris, confirmation well in Glasscock Bend conglomerate field, and northwest offset location, in the J. U. Fields Survey, completed for 83.8 bbl. of oil a day, flowing through ¼-in. choke. Pay was from 5,904-17 ft., with total depth at 5,938 ft. This well is producing from a section some 400 ft. below the discovery and is said to be one of the deepest yet found in the area.

Clay County.—L. T. Burns 12 W. M. McGregor, 8 miles northeast of Scotland, but across the county line, recovered 300 ft. of free oil, plus 120 ft. of heavily oil-cut mud, on a 90-minute drill-stem test of a sand from 4,679-89 ft. Bottom-hole flowing pressure was 150 psi. It was to be drilled another 50 ft. before surveying and setting casing for completion tests.

Montague County.—Continental Oil Co. 1 S. E. Brown, J. A. Schnell Survey, was a prospective ½-mile north extender to Hildreth Bend conglomerate field when it recovered 300 ft. of free oil and 60 ft. of oil-cut mud in a 2-hour drill-stem test from 5,923-38 ft. Gas came to the surface in 10 minutes. Bottom-hole pressure was 900 psi.

Continental staked location for a 7,400-ft. Ellenburger wildcat 3 miles south of Bowie and 2 miles south of McNutt field. The new well is its 1 E. L. Edgin, 1,500 ft. from north and 4,200 ft. from west lines, Isaac Garner Survey, A-1287.

Two miles southeast of Mallard, L. W. Barrett 1 Fred Williams, I. D. Trimmer Survey, A-1329, outpost test to conglomerate production, drilled oil shows from 6,366-70 ft., then ran a 3-hour drill-stem test from 6,342-70 ft. Gas showed in 4 minutes and oil in 28 minutes. It was allowed to flow 112 bbl. of oil into tanks. Recovery in the pipe was 900 ft. of oil, 90 ft. of oil-cut mud, and no water. Shut-in bottom-hole pressure was 1,950 psi. in 20 minutes. Operators set casing at 6,355 ft. for completion.

Gulf Oil Corp. 1 M. E. McDonald, W. Watson Survey, ½ mile southwest of Belcherville, recovered 810 ft. of salty mud on a 90-minute drill-stem test in conglomerate from 5,975-6,085 ft. It was shut down at 6,086 ft. for orders.

S. D. Johnson 1 A. L. Reed, Block 36, J. H. Belcher Survey, 1½ miles southeast of Belcherville, was reported at 4,020 ft., total depth, and preparing to drill-stem test in the Strawn. Further details were not disclosed.

Wilbarger County.—A 1-mile southeast extension to new Ellenburger production 18 miles south of Vernon, was reported at W. T. Waggoner 2-TT Fee, 21-3-H&TC. Top of the Ellenburger was 4,795 ft., drilled to 4,816 ft. Completion was for 120 bbl. of 39°-gravity oil in 6 hours through ¼-in. choke.

NORTH CENTRAL TEXAS (DISTRICTS 9 AND 7-B) SUCCESSFUL WILDCATS

Archer County: E. B. Clark Drilling Co. 1 Ferguson Bros., Sec. 1, SPRR Sur., A-416, 2 mi. N Mankins, pumped 73 bbl. 42°-gravity oil a day, sand 3,550-60 ft., GOR 400 cu. ft., TD 3,575 ft.

E. B. Clark 1 C. A. Miller, Blk. 21, Mangold Subd., 2 mi. N Mankins, pumped 59 bbl. 42°-gravity oil a day, sand 3,550-70 ft., TD 4,044 ft.

Clay County: L. T. & Bobby Burns 11 McGregor, Sec. 4, M. Quinn Sur., A-1152, 8¼ mi. NE Scotland, flowed 101 bbl. 42°-gravity oil, Caddo 4,658-73 ft. TD, 16/64-in. choke, GOR 530 cu. ft., CP 470 psi., TP 160 psi.

Jack Grace Producing Co. 1 D. M. Cobb, J. Scott Sur., A-691, 7½ mi. NW Shannon, flowed 408 bbl. 41°-gravity oil a day, lime 5,590-5,600 ft. TD, 16/64-in. choke, GOR 826 cu. ft., CP 650 psi., TP 175 psi.

Young County: Signal Oil & Gas Co. and Ben H. Rankin 2 G. D. Hunt, J. McCann Sur., A-1496, 11 mi. W Graham, pumped 4 bbl. 42°-gravity oil a day, top pay 4,672 ft., TD 4,730 ft.

Willis Drilling Co. 1 G. R. Funk, W. R. Oxford Sur., A-216, 4 mi. SE Bunger, flowed 25,400,000 cu. ft. gas a day, 1,060 psi. shut-in pressure, gas pay 2,300-14 ft., TD.

NORTH CENTRAL TEXAS (DISTRICTS 9 AND 7-B) WILDCAT FAILURES

Archer County: L. T. Burns 1 Knowles, Sec. 8, SPRR Sur., A-1302, 6 mi. N Scotland, dry, TD 6,000 ft., oil odor 5,322-47 ft.

Childs & Riddle 1 L. F. Wilson, Lot 3, Blk. 36, ATNC Sur., 11 mi. N Archer City, dry, TD 1,600 ft., Gunsight 1,568 ft.

Taylor, West and Lemaster 1 W. Duckworth, Blk. 8, J. W. Harris Sur., 7 mi. NE Megargel, dry, TD 1,435 ft., Gunsight 1,369 ft.

W. M. Vandivert 1 L. M. Hayter, Sec. 2423, TE&L Sur., A-600, 1 mi. SE Megargel, dry, TD 1,515 ft., Gunsight 1,469 ft.

Baylor County: Mudge Oil Co. 1 J. M. Hrncirik, Sec. 2471, TE&L Sur., 3 mi. NW Megargel, dry, TD 5,296 ft., Mississippian 5,220 ft.

Callahan County: A. G. Hill 2 Maggie Hardy Heirs, Sec. 24, ETRR Sur., 7 mi. N Baird, dry, TD 4,795 ft., Caddo 4,160 ft., elev. 1,852 ft.

Comanche County: Robert A. Shaw 1 J. H. James, Blk. 19, Lampasas CSL, 3 mi. N Sidney, dry, TD 2,817 ft., Caddo 2,050 ft., elev. 1,488 ft.

Cooke County: Wilcox Oil Co. and D. H. Bolin 1 Tony and Al Hesse, Lot 2, Patsey Lewis Sur., A-565, 2 mi. SW Muenster, dry, TD 2,011 ft.

Eastland County: Dunn Bros. et al 1 A. D. Tindall, Sec. 6, Blk. 6, E&RR Sur., 3 mi. NE Eastland, dry, TD 1,448 ft.

V. M. Gamblin 1 C. S. Daniel, 2-2-BBB&C Sur., 3 mi. S Dotham, dry, TD 525 ft.

Fisher County: Skelly Oil Co. 1 G. C. Shell, 1-2-H&TC, 2½ mi. W Royston, dry, TD 6,282 ft., King sand 3,887 ft., Swastika 3,958 ft., Mississippi 6,055 ft., Ellenburger (?) 6,213 ft., elev. 1,987 ft.

Humble Oil & Refining Co. 1-B Jeannette Nickless, Blk. 2, G. W. Lawrence Sur. 330, 2 mi. N Sylvester, dry, TD 6,460 ft., Noodle Creek 3,125 ft., Saddle Creek 3,363 ft., Flippen 3,443 ft., Ellenburger 6,225 ft., elev. 1,922 ft.

Hamilton County: The Stevens - Stephens Co., Inc., 1 Mary Hebener, P. R. Ramsey Sur., 15 mi. SW Hamilton, dry, TD 4,275 ft., Barnett shale 3,990 ft., elev. 1,290 ft.

Jones County: Three Brothers Oil Co. 1 J. A. & Roy Crow, Sec. 24, D&DA Sur., 1 mi. W Avoca, dry, TD 2,152 ft.

Three Brothers Oil Co. 1 J. E. Manley, 72-14-T&P, 8 mi. S Nugent, dry, TD 3,804 ft.

Knox County: Bolin Oil Co. 1 I. Walling, 95-2-D&W, 6 mi. W Mundy, dry, TD 2,102 ft.

Montague County: Reagan Caraway 1 Crow, J. P. Francis Sur., A-264, 3½ mi. NW Nocona, dry, TD 5,600 ft.

Shackelford County: Penn Fulwiler & Swink 1 F. B. Cloud, 39-11-T&P, 7 mi. SW Albany, dry, TD 1,073 ft.

West & Hinea 2 Reaves-Hickman, Sec. 64, Asylum Lands, 12 mi. S Albany, dry, TD 1,065 ft.

Stonewall County: Barnsdall Oil Co. 1 Sloane Callaway, 62-F-H&TC, dry, TD 6,350 ft., Valera 2,210 ft., Swastika sand 3,650 ft., Reef 5,520 ft., Ellenburger 6,325 ft.

Taylor County: Hickok & Reynolds 2 W. B. Payne, Sec. 2, Burr & Caswell Sur., 10 mi. S Merkel, dry, TD 3,103 ft.

Sojourner Drilling Co. 1 W. K. Knight, 32-17-T&P, 1 mi. SE Tye, dry, TD 2,703 ft.

West Central Drilling Co. 1 H. H. Teaff, Blk. 17, Lge. 124, Grimes CSL, 4 mi. NE Merkel, dry, TD 2,691 ft.

LA.-ARK.

Bistineau Field Outpost Coring Below 5,744 Ft.

SHREVEPORT.—Midstates Oil Corp. 1 S. L. Carter, NE SE 12-16n-10w, Bienville Parish, outpost test to the Bistineau field, was coring ahead below 5,744 ft. in the Travis Peak. Cores from 5,366-5,484 ft. recovered shale and lime having fair shows of distillate throughout. A drill-stem test from 5,383-91 ft., in the Pettit zone, open 18 minutes, recovered 870 ft. of salt water with gas odor. Bottom-hole flowing pressure was 1,275 psi., with ¼-in. chokes.

On an elevation of 176 ft., the 1 Carter found the Massive anhydrite from 4,115-4,200 ft., and Pettit porosity at 5,380-5,490 ft., by samples.

In Bossier Parish, C. H. Murphy 1 Crystal Oil & Refining Corp., 14-12w, was drilling at 6,382 ft., in the Travis Peak. Cores in the Pettit at 6,288-92 ft. recovered 9½ ft. of lime and shale with no shows.

Union Producing Co. 1 Section 13 Unit, 13-17n-12w, Cotton Valley wildcat, was drilling at 7,615 ft. in the Travis Peak with no shows reported. Location is in the Sligo field.

Two miles north of Columbia, Caldwell Parish, C. H. Murphy 1 W. W. Meredith, irregular Section 41-13n-4e, was drilling at 5,170 ft. in the upper Cretaceous. A core at 4,352-57 ft. recovered 5 ft. of salt water sand. It is a new operation, located on a subsurface prospect and was scheduled to the Tuscaloosa.

Hunt Oil Co. 16 Louisiana Delta, 27-4n-5e, 6 miles southeast of the Saline Lake field, reported a slight show of oil in cores from 5,830-40 ft. A 35-minute drill-stem test from 5,832-40 ft., using ¼-in. chokes, recovered 1,730 ft. of salt water with no shows. Bottom-hole flowing pressure was 2,525 psi. Operators drilled ahead below 6,535 ft., in the Wilcox.

Interstate Natural Gas Co.'s 1 Tensas Delta, 11-9n-7e, Tuscaloosa test in the Sicily Island field of Catahoula Parish, reported sample top on the Tuscaloosa at 7,863 ft. Elevation is 61 ft. It was drilling ahead at 8,202 ft.

Marine Oil Co. 1 Farrar, new operation 7 miles northeast on the Saline Lake field, 19-5n-6e, Catahoula Parish, was coring at 5,263 ft., in the Wilcox topped at 4,086 ft. Recovery was sand and shale with no shows.

Ohio Oil Co. et al 1 O. L. Martin, 3-22n-7w, Claiborne Parish, was reported in the Cotton Valley formation in drilling below 7,773 ft.

Southwest Gas Producing Co. 1 J. L. Liggin, 9-20n-2w, Lincoln Parish, was nearing contract depth of 8,800 ft., with no further shows reported below 8,394 ft.

NORTH LOUISIANA WILDCAT FAILURE

Claiborne Parish: Haynes B. Ownby Drilling Co. 1 J. P. Malone, NE SE 36-21n-6w, dry, TD 6,175 ft., Nacatoch 2,083 ft., Massive anhydrite 4,260-4,498 ft., Gloyd 4,886 ft., James 5,140 ft., elev. 187 ft.

ARKANSAS WILDCAT FAILURES

Lafayette County: E. L. Pinkston 1 C. N. Knighton, NW SE NE 15-15s-23w, dry,

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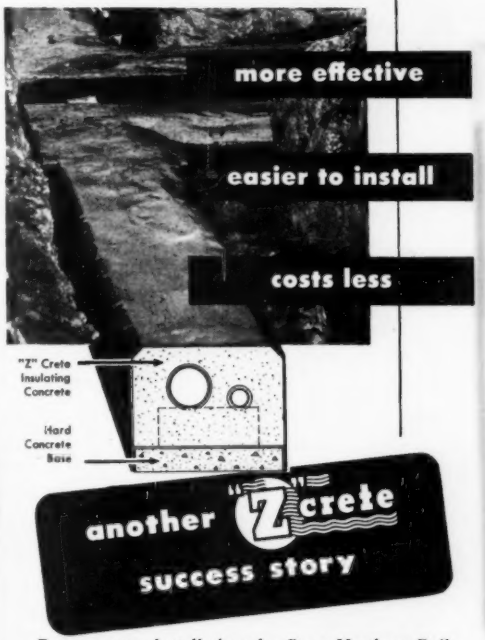

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Ouachita County: Jack Carnes 1 Joe Edwards, SW NW NW 5-15s-19w, dry, TD 4,007 ft., no shows.

St. Francis County: Carson-Sands 1 L. E. Porter, NE NE 20-4n-1w, dry, TD 2,754 ft.

Union County: El Dorado Drilling Co. 1 J. L. Foster, NW SE NW 3-18s-16w, dry, TD 2,199 ft.

APPALACHIAN FIELD

West Virginia Wildcat Completed as Gasser

PITTSBURGH.—A successful wildcat has been completed and turned into line in Portland district, Preston County, West Virginia, at its Nollem Oil & Gas Co.-Snee & Eberly 1 Hugh R. and Jas. A Fitzparick, elevation 2,228 ft., gaging 225,000 cu. ft. of gas in the Oriskany sand, total depth 6,221 ft. This well was not acidized. Rigging up operations have been commenced by Snee & Eberly in No. 2 Cora E. Lewis. This well is located on the Kingwood Quadrangle approximately 1,700 ft. Southwest of No. 1.

In Reno district, Snee & Eberly 1 Dola E. Dever, elevation 1,508 ft., resulted in a dry hole in the Oriskany sand, total depth 5,585 ft.

A deep well in Pocatalico district, Putnam County, Godfrey L. Cabot, Inc., No. 40-1298 J. L. McLean Heirs, gaged 3,639,000 cu. ft. of gas in the Oriskany sand, total depth 4,984 ft.

Good shallow sand gas wells were noted: Clear Fork district, Raleigh County, United Fuel Gas Co., No. 11-6537 Coal River Mining & Lumber Co., 1,565,000 cu. ft. of gas, Weir sand, total depth 2,426 ft.; Baileysville district, Wyoming County, United Producing Co. 85-1635 W. M. Ritter Lumber Co., 2,214,000 cu. ft. of gas, Berea sand, total depth 3,551 ft.

New locations reported in West Virginia were 13: Otter district, Braxton County; Lee and Sherman districts, Calhoun County; Grant district, Doddridge County; Center and Glenville districts, Gilmer County; Ravenswood district, Jackson County; Mannington district, Marion County; Liberty district, Marshall County; Harvey district, Mingo County; and Murphy district, Ritchie County.

In Wharton Township, Fayette County, Pennsylvania, William E. Snee et al No. 3 Indian Creek Coal & Coke Co., elevation 2,615 ft., reported the Tully lime at 6,326-6,410 ft., with drilling at 6,496 ft.; Georges Township, Orville Eberly et al, No. 1 N. E. Murphy, elevation 2,560 ft., is drilling at 2,230 ft. Napier Township, Bedford County, South Penn et al-Snee & Eberly, No. 1 Jesse B. Miller, elevation 1,666 ft., is drilling at 4,450 ft.

New locations reported in Pennsylvania were seven: Boggs, Mahoning and Kittanning townships, Armstrong County; Porter Township, Clarion County; Burrell Township, Indiana County; and in Clover and Union townships, Jefferson County.

WEST VIRGINIA SUCCESSFUL WILDCAT

Preston County, Portland district: Nollem Oil & Gas Co.-Snee & Eberly, 1 Hugh R. and Jas. J. Fitzpatrick, elev. 2,228 ft., 225,000 cu. ft. of gas, Onondaga lime, 5,485 ft., chert 5,505 ft., Oriskany sand 5,652 ft., gas 5,652 ft., TD 6,221 ft.

WEST VIRGINIA WILDCAT FAILURE

Preston County, Reno district: Snee & Eberly, No. 1 Dola E. Dever, elev. 1,508 ft., dry, Onondaga chert 5,169-5,312 ft., Oriskany sand 5,321-5,415 ft., salt water 5,410 ft. which exhausted. TD 5,585 ft.

ROCKY MOUNTAIN

Sinclair Finds Oil in Fremont County Test

DENVER.—Oil was recovered on drill-stem test of the Nugget between 7,268-7,293 ft. at Sinclair Oil & Gas Co. 1 Unit, SE SW SW 16-28n-93w, wildcat on the Happy Springs Unit, Fremont County, Wyoming. In the base of the section between 7,293-7,330 ft. the well made 357 ft. of thin mud and 2,878 ft. of oil and water, indicating that the producing zone may be thin. Sinclair found oil in the Frontier and Muddy sands in this well but recovered only water from the Lakota, one of the principal objectives. The wildcat is located west of Sinclair's Crooks Gap field, which produced oil from Muddy and Lakota sands.

Phillips Petroleum Co. recovered 2,200 ft. of 25°-gravity clean oil and 90 ft. of oil-cut mud from the Dakota, a new pay for South Cole Creek field, on 30-minute drill-stem test. The well is 3 Cole, SW NE SW 17-34n-76w, Converse County, Wyoming, and previous oil producers in the field have been completed in the Lakota. Dakota staining was found in the discovery well, which Phillips completed last year, but tests did not indicate as much production as in the present well. The second well on the structure was drilled to 10,207 ft., total depth, into Pennsylvanian, and plugged back for a 460-bbl. per day producer from Lakota.

Numerous locations for extension wells west of Fiddler Creek and east of Hay Creek, Weston County, Wyoming, have been made following excellent completions in this area. Most recent is Wm. Tomberlin 1 State, C NE SE 20-46n-65w, ½ mile north of production in the new area. The well flowed 132 bbl. of oil per hour through ½-in. choke from Newcastle between 5,072-5,087 ft. This is the fifth excellent completion west of Fiddler Creek field proper in recent weeks. Newcastle production was first found in this field in 1948, and there has been continuous drilling, with some dry holes, since that time. Recently a pipe line was completed from this field to a station at Mush Creek, 10 miles southeast, and a line from that station 60 miles south to Lance Creek is now under construction.

Water was recovered on drill-stem test in the Dakota at the Pitts-Colorado wildcat at 1-A Williams, SE SW NW 2-3n-92w, Coles Dome, Moffat County, Colorado, after staining had shown in the zone. The test was made between 3,194-3,223 ft. and 28 stands of water was recovered in 15 minutes. The operator is drilling ahead for a test of Morrison and Sundance.

New locations.—There were 18 new locations, with 10 in Wyoming, 3 in Colorado, 3 in Montana, and 1 each in Utah and Nebraska. In Utah a new wildcat is being started by Sun Oil Co. at 1 Neill-Government, NE SW SE 26-4s-22e, Brush Creek area, and the well will be a Weber test to around 4,500 ft. The block is located northeast of Ashley Valley field, which produces oil from Weber. In Colorado Utah Vernal Oil Co. is moving in materials for a 5,000-ft. Wasatch test at 1 fee, SW SW SE 9-9n-93w.

Completions.—There were 37 completions, with 25 in Montana, 7 in Wyoming, 2 each in Colorado and Utah and 1 in North Dakota. The North Dakota wildcat was John Hammond et al failure in the Grand Forks area, which reportedly went into granite at around 500 ft. In Wyoming failures were plugged at Foote Creek, Carbon County, and Little Dome, Fremont County. The Foote Creek well was drilled by California Co. to Tensleep, where it showed water. At Little Dome, Pacific Western Oil Co. went into Embar, where water was recovered. W. C. McBride, Derby Oil Co., and E. K. Carey Drilling Co. plugged a Weber test in the Axial Basin area, Moffat County, Colorado, at 3,420 ft., total depth.

WYOMING WILDCAT FAILURES

Foote Creek, Carbon County: California Co. 1 Hodges, SW NE SE 26-22n-78w, 2,642 TD, plugged and abandoned, Morrison 240 (sample top), Sch tops: Sundance 570, Jelm 800, Chugwater 925, Tensleep 2,226.

Little Dome, Fremont County: Pacific Western Oil 1 Tribal, NE NE NE 15-5n-1w, (WRM), 3,708 TD, plugged and abandoned, Morrison 75, Sundance 515, Gypsum Springs 870, Nugget 1,155, Chugwater 1,227, Dinwoody 2,735, Embar 3,272, Fault 3,550, Dinwoody 3,550, Embar 3,690.

COLORADO WILDCAT FAILURE

Axial Basin, Moffat County: W. C. McBride-Derby Oil Co.-E. K. Carey 1 Ford-Sweeney, SE NW NE 17-5n-94w, 3,416 TD, plugged and abandoned, electric log tops: Dakota 413, Morrison 630, Curtis 1,133, Entrada 1,269; sample tops: Navajo 1,570, Chinle 1,953, Shinarump 2,220, Weber 2,885.

MONTANA SUCCESSFUL WILDCAT

Devils Pocket, Musselshell County: William Hanlon 2 Hanlon-Dalton, NE SW NE 9-10n-22e, 2,472 TD, PG 1,935, initial production 60 bbl. oil per day, Ellis 1,180, 4,000 M.c.f. gas per day, Amsden 1,405, 51,250 M.c.f. gas per day, Heath 1,600, Otter 1,965, Kibbey 2,221 (Heath discovery, new field).

UTAH WILDCAT FAILURE

Naples area, Uintah County: Equity Oil Co. 1 Kendall, SW NE SW 33-4s-22e, 4,922 TD, plugged and abandoned, Frontier 1,295, Dakota 1,665, Entrada 2,733, Carmel 2,930, Navajo 3,060, Chinle 3,816, Phosphoria 4,746, Weber 4,907.

NORTH DAKOTA WILDCAT FAILURE

Grand Forks, Grandforks County: John

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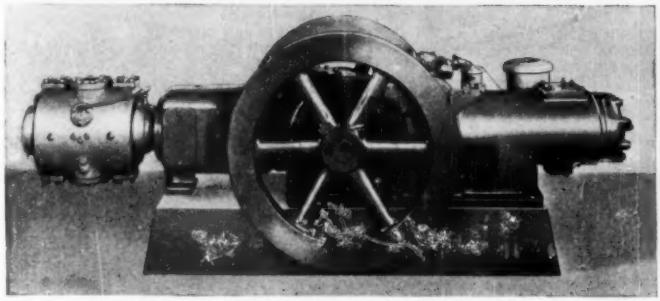

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Hammond et al 1 Berg, C NE NW 35-151n-52w, 1,665 TD, plugged and abandoned, granite 500.

SOUTHWEST TEXAS

East White Point Field Extended by Completion

CORPUS CHRISTI. — East White Point field in San Patricio County has been extended ½ mile eastward by the completion of H. R. Smith et al 1 John G. Davis. The well flowed 142 bbl. of 39.6°-gravity oil through a ⅛-in. choke through perforation at 5,656½-59 ft. Total depth of the well is 5,663 ft.

Taylor Refining Co. is preparing to perforate a new sand from 4,200-04 ft. in the 1 Claude King, Sr., outpost test to the North Rincon field, which will extend the field on the southwest side. The well was drilled to a depth of 5,512 ft., then sidetracked and drilled to a depth of 4,204 ft. in a new hole. On 5-minute drill-stem test at 4,200-04 ft., the well recovered 100 ft. of oil and 20 ft. of oil-cut mud, and developed 44-psi. working pressure.

Rowan & Hope have completed the 1 H. M. Roark as a new oil discovery well in McMullen County. The well was completed in the same section from which the well recovered oil in the Wilcox zone on a drill-stem test made previously. Operators set 7-in. casing to 5,120 ft. after making test, then drilled ahead below the pipe to a depth of 5,791 ft., where an electric log was run with no further indications of oil or gas shows. The hole was then plugged back inside the bottom of the casing which was perforated for the completion in the 5,100-ft. sand. The well flowed 61 bbl. of 38°-gravity oil per day through a ⅛-in. choke through perforations at 5,090-110 ft. with 675-psi. tubing pressure. Location of the well is in the J. M. Hernandez Survey 34, Abstract 225.

The Gasoline Production Corp., Ralph Rowden and Dale H. Rowden promise to open a new pool in Duval County. After running a series of drill-stem tests in the 2,500 and 2,600-ft. level the recovery was gas-cut drilling mud. Operators plan to core at 2,680 ft. in the Loma Novia sand. The test is the 1 John P. Akin-State of Texas, in F. E. Stearns Survey 184, approximately 11 miles southwest of Freer.

Another prospective discovery for Duval County is the Delhi Oil Corp. 2 Hagist Ranch, in Z. Benson Survey 268, 11 miles north of Freer. The well cored unbroken gas-distillate sand from 7,122-96 ft. On 15-minute drill-stem test at 7,122-29 ft. the well recovered 5 ft. of distillate and developed 290-psi. working pressure. Another 15-minute drill-stem test at 7,220-30 ft. recovered 1,147 ft. of brackish water with a rainbow of oil.

The 44 new locations in Southwest Texas include 7 wildcat starts, one each in San Patricio, Burnet, Medina, Uvalde and Williamson counties, and 2 in Duval County. There were 2 successful exploratory wells completed, 1 each in Bastrop and Zapata counties, while 14 were dry, 1 each in Caldwell, Frio, Milam, Travis, Val Verde, Aransas, Cameron, Jim Hogg and Zapata counties, 2 in Williamson County and 3 in Webb County.

SOUTHWEST TEXAS (DISTRICTS 1 AND 4) SUCCESSFUL WILDCATS

Bastrop County: New oil discovery—Jesse I. White 1 Martin McDonald, M. Baker Sur., 8 mi. SW of Bastrop, top sand 1,869 ft., TD 1,881 ft., open hole 1,869-81, IP: 112 bbl. oil per day, ¼-in. choke, GOR 200, 40° gravity, CP 175 psi.

Zapata County: Gas discovery—W. B. Jayred 1 Jose M. Gutierrez, at Cinco de Mayo, Porcion 30, 11 mi. E of Zapata, top sand 2,300 ft., TD 6,515 ft., perf. 2,300-10 ft., IP: 3,590 M.c.f. gas per day open flow, SIP 1,075 psi.

SOUTHWEST TEXAS (DISTRICTS 1 AND 4) WILDCAT FAILURES

Aranasas County: Heep Oil Corp. 1 W. H. Wheeler, J. F. Smith Sur., 4 mi. SW of Rockport, dry, TD 8,050 ft.

Caldwell County: Tarpon Oil & Gas Co. 1 Chaudion et al, Nancy Reavill Sur., dry, TD 2,307 ft.

Cameron County: McCarthy Oil & Gas Corp. 1 Frank J. Anderson, Tract 2, LaFeria Grant, 3 mi. SE of Santa Maria, dry, TD 13,066 ft.

Frio County: Humble Oil & Refining Co. 1 H. R. White, in James Spillman Sur., 971½, 3 mi. W of Hindes, dry, TD 6,002 ft.

Jim Hogg County: Dulaney Oil Co. 3 Robert Holbein et al, Block 80, Las Animas Grant, 16 mi. S of Mirando City, dry, TD 2,408 ft.

Milam County: A. J. Skidsson 1 H. P. Culpepper, S. C. Robertson Sur., 2 mi. NE of Cameron, dry, TD 965 ft.

Travis County: Tamd Oil Corp. 2 Maggie Burleson, James Gilliland Sur., 7 mi. S of Manor, dry, TD 1,570 ft.

Val Verde County: O. W. Killam 1 Walter Babb, I&GN RR Sur. 104, 2 mi. SW of Mertzon, 3 mi. E of Middleton, dry, TD 2,740 ft.

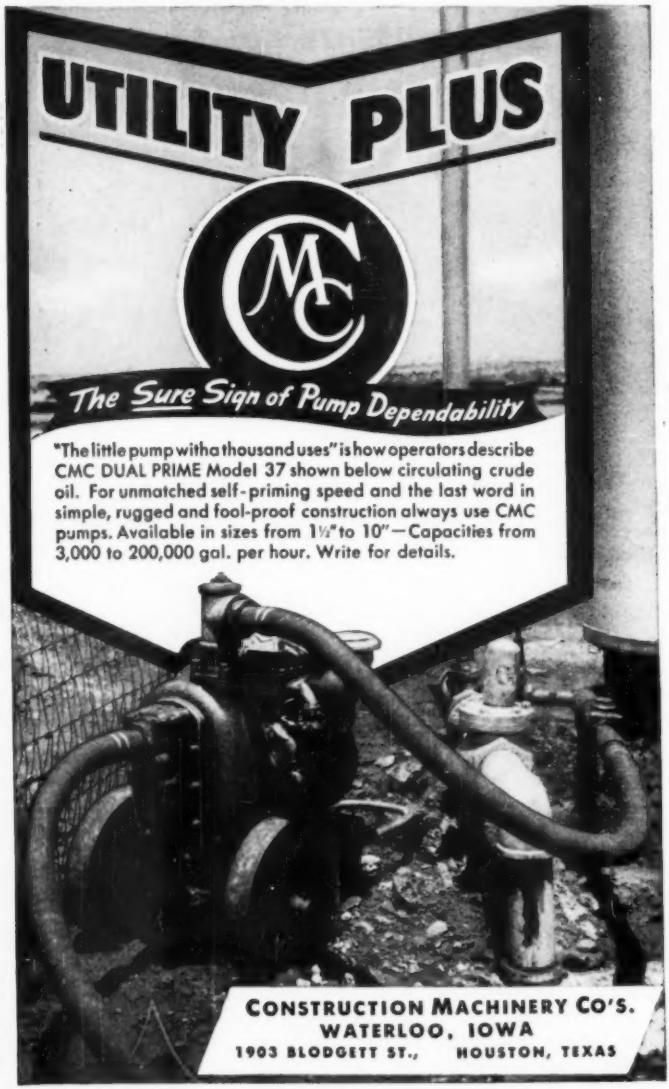
Webb County: Sid Katz, R. H. Venable & W. E. Fox, Trustee, 1 J. E. Neal, Sur. 716, 5 mi. SW of Bruni, 2¼ mi. N-NE of McLean field, dry, TD 3,923 ft.

O. W. Killam 1 Garza fee, Sur. 2257, 11 mi. N of Bruni, 2 mi. S of Lopez field, dry, TD 3,230 ft.

O. W. Killam 1 Marrs-McLean, Sur. 613, 7 mi. SW of Bruni, dry, TD 3,533 ft.

Williamson County: Anderson Prichard Oil Corp. 1 S. R. Ging, J. Sappington Subd., 1 mi. S of Coupland, dry, TD 1,335 ft.

Jesse Russell 1-A Isabella H. Roberts,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Thos. F. Gray Sur., 5 mi. NW of Liberty Hill, dry, TD 3,000 ft.

Zapata County: Dulaney Oil Co. 7 Alice Doran Haynes, Block 29, Villa Grant, 17 mi. S of Escobas, dry, TD 841 ft.

TEXAS GULF COAST

Montgomery County Gets Gas-Distillate Discovery

HOUSTON.—Sterling Oil & Refining Co. and Daugherty & Kidd have completed the 1 W. Schiel as a gas-distillate discovery 4½ miles northwest of Tomball townsite, Montgomery County. The well is bottomed at 5,675 ft. and is flowing gas and distillate through perforations at 5,486-91 ft. in the Cockfield sand, with tubing pressure of 1,850 psi. and casing pressure at 1,900 psi. The well is located in the J. Stansbury Survey, Abstract 485.

Evergreen field of San Jacinto County has been extended ½ mile northeastward at the Butcher-Arthur, Chicago Corp., and Daugherty & Kidd 1 Polk, Vital Flores Survey, Abstract 14. The well flowed an unestimated amount of gas and condensate from perforations in the Wilcox at 7,571-82 ft. Shut-in pressure is 2,200 psi.

Final completion has been made at the E. G. Goforth 1 fee, the first producer for Grimes County. The well gaged 1,000,000 cu. ft. of gas daily plus 25 bbl. of condensate, through perforations at 7,604-11 ft. in the Wilcox sand. The discovery is in the William Berryman Survey, 1 mile southwest of Todd.

Skelly Oil Co. is completing a new oil producer approximately 1 mile northwest of Yoward field, Bee County. The 1 George W. Goree cleaned out for completion after drill-stem test in perforations at 7,199-202 ft., and flowed 20 bbl. of 40.3°-gravity oil in 8 hours through a 9/64-in. choke. Total depth of the well is 8,201½ ft.

Henderson Coquat and Sunray Oil Corp. have staked location for a 7,500-ft. confirmation test to the North Goebel field, Live Oak County. The new test is 1,000 ft. southeast of the A-1 Goebel discovery, Refugio County School Lands Survey 6.

The 43 new locations on the Texas Gulf Coast include 15 wildcat starts, 1 each in Jackson, Lavaca, Live Oak, Brazoria, Chambers, Hardin, Montgomery, and Wharton counties, 2 each in Refugio and Victoria counties, and 3 in Bee County. There were three successful exploratory tests completed, one each in Jackson, Grimes, and Matagorda counties, while eight were dry, one each in Jackson, Victoria, Chambers, Colorado, Grimes, Polk and two in San Jacinto County.

TEXAS GULF COAST (DISTRICTS 2 AND 3) SUCCESSFUL WILDCATS

Grimes County: Gas-condensate discovery—E. G. Goforth et al 1 E. G. Goforth fee, Wm. Berryman Sur., 1 mi. SW of Todd, top sand 7,600 ft., TD 8,500 ft., perf. 7,604-11 ft., IP: 25 bbl. condensate per day, 1,000 M.c.f. gas per day, TP 2,200 psi., SIP 2,400 psi.

Jackson County: New oil pool—Houston Oil Co. of Texas A-1 B. W. Trull, Pat Green Sur., A-25, in Francitas area, top sand 7,964 ft., TD 10,514 ft., perf. 7,947-53 ft., IP: 61 bbl. oil per day, 41.4° gravity, GOR 2,397, TP 740-800 psi., ⅛-in. choke.

Matagorda County: Gas discovery, Palacios area—Grubb & Hawkins 1 Margerum et al Unit, Lewis Goodwin Sur., A-162, top sand 9,150 ft., TD 9,308 ft., perf. 9,150-218 ft., no gage, SIP 6,700 psi.

TEXAS GULF COAST (DISTRICTS 2 AND 3) WILDCAT FAILURES

Chambers County: Phillips Petroleum Co. A-1 Daw, in Wm. Moore Sur., A-184, dry, TD 13,150 ft.

Colorado County: Casey & Weempe 1 Lee Estella Brownson, Asa McClure Sur., A-411, 13 mi. SW of Garwood, dry, TD 4,205 ft.

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Grimes County: The Texas Co. 1 J. W. Harris, Amos Edson Sur., A-188, 3½ mi. SW of Singleton, dry, TD 7,965 ft.

Jackson County: P. T. Sharples 2 Edmonia Pressley, Peter White Sur., 9 mi. N of Edna, dry, TD 3,700 ft.

Polk County: Wilbur E. Thomas 1 F. S. Clancy, Reuben Lynch Sur., 1 mi. NW of Onalaska townsite, dry, TD 5,250 ft.

San Jacinto County: J. R. Frankel 1 Frank Hogue, E. Russell Sur., 14 mi. SW of Cold Springs, 4 mi. NW of Mercy field, dry, TD 8,295 ft.

W. B. Jayred 1 W. R. Stephens, H&TC Sur., 97, 4 mi. NE of Cleveland, dry, TD 5,350 ft.

Victoria County: Baldridge & King, Inc., 9 Mary C. Simmons, S. Serna Sur., A-106, 14 mi. S of Victoria, dry, TD 6,088 ft.

MICHIGAN

Bay County Field Finds Traverse Lime Production

MOUNT PLEASANT.—Don Rayburn had a new Traverse lime oil discovery in Pinconning Township, Bay County, as his 2 Cooper-Lucht, NE SW NE 29-17n-4e, was rated good for at least 60 bbl. of oil a day at 2,283 ft., total depth. Well was showing a 4 per cent watercut at this restricted flowrate. Traverse top was logged at 2,105 ft.

Rayburn's 1 Cooper-Lucht, SW SW NE 29-17n-4e, diagonal southwest 20-acre offset and the first well to log a Traverse pay, was completed dry after tests indicated that a heavy water log was drowning out a possible oil pay. Oil in this test was discovered when a blow-out occurred while hole was being drilled with rotary tools towards the original objective, the Dundee.

Spacing regulations and proration orders affecting six Michigan fields were announced by Supervisor of Wells P. J. Hoffmaster following a public hearing in Lansing September 7.

A diagonal 20-acre well-spacing pattern was established for the new Crooked Lake field, Allegan County, which is being developed by Ohio Oil Co. Spacing pattern for wells in the Kawkawlin Dundee pool, Bay County, was set up for one well in the center of each regular 20-acre unit. Spacing regulations became effective immediately.

Wells in the Sylvan Dundee field, Osceola County, were restricted to 85 bbl. of oil a day, while Richfield horizon producers in the Beaver Creek pool, Crawford and Kalkaska counties, St. Helens field, Roscommon County, and South Adams pool, Arenac and Bay counties, were limited to 100 bbl. per well a day, effective October 1.

The State of Michigan leased 15,283 acres of 20,754 acres of state-owned lands at public auction September 8, for a total bonus of $8,750—one of the smallest state land sales ever held in Michigan. All lands leased were classified as wildcat and the average price per acre was 57 cents.

MICHIGAN SUCCESSFUL WILDCAT

Bay County, Pinconning Township: Don Rayburn 2 Cooper-Lucht, NE SW NE 29-17n-4e, Traverse 2,105 ft., 60 bbl. oil, 4 per cent water, TD 2,283 ft.

MICHIGAN WILDCAT FAILURES

Allegan County, Monterey Township: Pascal F. Broughton 1 Conner, SE NE NW 33-3n-13w, Traverse 1,596 ft., dry, TD 1,636 ft.

Barry County, Carlton Township: Merrill Drilling Co. 1 Frisby, SE SE SE 7-4n-8w, Traverse 2,050 ft., dry, TD 2,104 ft.

Bay County, Pinconning Township: Don Rayburn 1 Cooper-Lucht, SW SW NE 29-17n-4e, Traverse 2,107 ft., dry, TD 2,242 ft., PBTD 2,236 ft.

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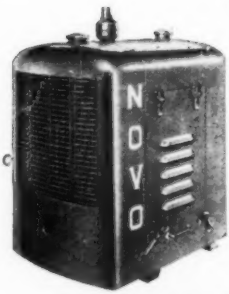

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Gratiot County, Arcade Township: Columbia Oil & Gas Co. 1 Wood, NW NE NW 32-11n-3w, Dundee 3,229 ft., dry, TD 3,282 ft.

Ionia County, North Plains Township: Harley Farrell 1 Corey, SW NW SW 12-8n-5w, Dundee 3,005 ft., dry, TD 3,064 ft.

Isabella County, Deerfield Township: Don Rayburn 1 Ludwick & Clark, NW SW SW 24-14n-5w, Dundee 3,654 ft., dry, TD 3,738 ft.

Newaygo County, Goodwell Township: Pure Oil Co. A-1 Miller, SE SW NE 23-14n-11w, Monroe 3,369 ft., dry, TD 3,498 ft.

Oceana County, Golden Township: Welsh Oil Co. 2 Munger, NE NE NE 18-15n-18w, Dundee 2,153 ft., dry, TD 2,167 ft. Golden Township: Mercer Oil Co., Inc., 1 Ruckel, SW SW SW 33-15n-14w, Dundee 2,238 ft., dry, TD 2,281 ft.

Van Buren County, Columbia Township: Ford Oil Co. 1 Thomas, SW NW NE 6-1s-15w, Traverse 1,200 ft., dry, TD 1,206 ft.

EASTERN TEXAS

Continental Plans Second Drill-Stem Test in Well

DALLAS.—Continental Oil Co. 1 Royall National Bank, A. G. Monroe Survey, A-56, Anderson County, had total depth at 9,711 ft., and was preparing to run a second drill-stem test at 9,629-9,711 ft. (Pettit) after the first encountered mechanical trouble.

The tester was open 50 minutes, using ¼-in. chokes and 4,950 ft. of water cushion. It produced a slight blow immediately, which died in 23 minutes. Recovery was the water blanket and 90 ft. of drilling mud having a light gas cut and rainbow show of oil. Flowing bottom-hole pressure was 2,300 psi. Shut-in. pressure was not recorded.

Cores from 9,661-9,7111 ft. recovered 52½ ft., being 21 ft. of hard, grey, slightly porous to nonporous lime, with some bleeding oil and gas bubbles on fresh break; balance of the recovery had no shows.

Humble Oil & Refining Co. 1 J. T. Ellis, W. A. Dunnagan Survey, A-236, was drilling in shale at 3,285 ft.

In Camp County, R. J. Caraway 1 Mrs. E. A. Chance, Pittsburgh area deep test, was below 12,774 ft. in lime.

Carter-Gragg Oil Co. 1 C. B. Robinson, James Heirs Survey, A-333, Pettit discovery in the Stewards Mill Woodbine field of Freestone County, was running tubing for production tests. Total depth was 8,150 ft., plugged back to 7,792 ft. Packer was to be set at 7,550 ft.

After plugging back, operators perforated in the Pettit at 7,600-45 ft. with 135 shots, and ran the testing tool with packer at 7,580 ft., ¼-in. chokes and 1,050 ft. of fresh water cushion. The water blanket was at the surface in 31 minutes, and unloaded in 36 minutes. Flowing pressure reached 1,600 psi. in 45 minutes and remained constant. The well was cleaned into pits through the ¼-in. chokes, making an estimated 2,100,000 cu. ft. of gas a day, plus an unestimated amount of amber-colored distillate.

Miles Producing Co. and J. E. Fleming 1 Crews Heirs, Smith County wildcat 5 miles northeast of Lindale, had total depth at 8,005 ft. and was shut down for orders. It reported a porous section of the upper Glen Rose lime, with some salt water, was topped around 7,990 ft.

Tide Water Associated Oil Co. and Seaboard Oil Co. 1 Wade, John H. Field Survey, Smackover test on the Kelsey salt dome of Upshur County, was drilling below 6,826 ft.

S. J. Carnes 1 Ida C. Lord, W. M. Speights Survey, A-193, 6 miles north of Milam in Sabine County, reported a drilling break at 5,779 ft., which drilled 1 min-

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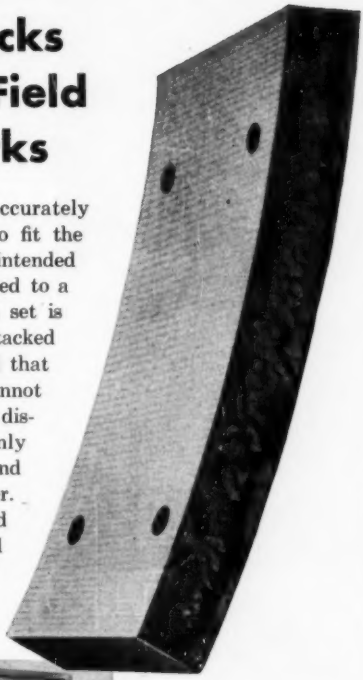

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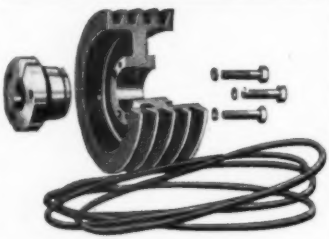

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ute per foot, but had no shows. It was drilling ahead below 5,975 ft. in hard lime and shale.

In Shelby County, R. Lacy, Inc., 1 Parker & Bridges, John Sanders Survey, A-690, was drilling below 5,503 ft. in hard lime and shale. A core from 5,317-22 ft. had 2½ ft. of brown porous lime, evenly stained with dark oil and with good odor, 1 ft. of slightly porous lime with uneven stains, and 1½ ft. of nonporous lime with no shows. A drill-stem test from 5,312-22 ft., open 1 hour, produced a strong blow immediately which continued throughout the test. Recovery was 115 ft. of drilling mud cut with oil and gas. The top 15 ft. was said to be very heavily oil-cut. Flowing bottom-hole pressure was 600 psi.

EAST TEXAS (DISTRICTS 5, 6, AND 6-P) WILDCAT FAILURES

Sabine County: Humble Oil & Refining Co. 1 J. W. Minton "B," Shadrack Morris Sur., 2,233 ft. NW 1 Minton, 9½ mi. NE Hemphill, dry, TD 8,238 ft., base Annona 4,447 ft., top Blossom 4,510 ft., by samples.

Walker County: C. J. McAlphin 1 Genoa Hubbard, John Coughran Sur., A-243, 5 mi. SW Weldon, well blew out at TD 926 ft., skidded rig 100 ft. due east.

KANSAS

Lyon County Pool Opener Swabs Oil-Water on Test

J. M. HUBER CORP.'S prospective new pool opener in Lyon County, its 1 Ball, NW SW NW 23-18s-10e, 6 miles north of Emporia, swabbed 9 bbl. of oil with 84 bbl. of water in the first 12 hours as testing of showings encountered in the Lansing-Kansas City lime got under way. The zone being tested is the same one in which a drill-stem test several weeks ago yielded a recovery of 5 ft. of clean oil and 85 ft. of oil-cut mud and gave impetus to the active wildcatting play along the east flank of the Nemaha ridge.

Since the drill-stem test, the hole has been deepened to the Arbuckle, topped at 2,943 ft. (—1,701 ft.) and drilled to 2,985 ft. With no important showings in the lower horizons, casing was run to 1,685 ft., through the Kansas City lime, based at 1,660 ft., and hole plugged back to that zone. Present testing is through casing perforations at 1,603-11 ft., with top of the Lansing at 1,261 ft. (—90 ft.). The previous drill-stem test took in an interval at 1,604-18 ft., and was followed by another at 1,618-25 ft., in which salt water was found.

Derby Oil Co. and Nate Appleman appear to have a good discovery in their 1-A Warren, NW NW NE 12-11-20, northwestern Ellis County. Located 3 miles south of the Berland pool, where an important producing area is being developed in Arbuckle lime, the new well swabbed 26 bbl. of clean oil per hour from Lansing-Kansas City lime, in which casing was perforated at 3,458-65 ft., with top of the zone at 3,409 ft. (—1,265 ft.). Prior to acidizing, the well swabbed at the rate of 2 bbl. an hour for 7 hours. Acidized with 500 gal., the well swabbed 15 bbl. an hour. An additional treatment of 2,000 gal. then was given, boosting the production to the 26-bbl.-per-hour rate. Hole had been drilled to the Arbuckle at 3,729-3,800 ft., but no important shows were found in that horizon.

Initial tests in Texas Pacific Coal & Oil Co. 1 Peterson, NW SW NE 17-18-2, another prospective discovery well 2 miles north of the McPherson pool, McPherson County, have not been so successful. Testing Simpson dolomite in open hole at 3,674-3,728 ft., it swabbed initially at the rate of 3 bbl. of oil per hour, but then made considerable water. Hole is being plugged back for tests higher in the pay.

In Morris County, Loomis et al 1 Atkinson, SW SW NE 15-17-5e, 3 miles east of the Lost Springs pool, got a 2,100-ft. fluid rise in the hole after drilling plug to test the Mississippian at 2,236-57 ft. The fluid is estimated at 1,800 ft. of oil and 300 ft. of water. The formation was topped at 2,232 ft. (—744 ft.). Casing was cemented 4 ft. in the top.

Carter Oil Co. 1-B Davis, SW NE NW 4-14-10e, a quarter mile south of the discovery well on the company's new Davis Ranch pool in Wabaunsee County, northeastern Kansas, established a maximum echometer potential rating (3,000 bbl. per day). The Viola pay zone in this well is producing through casing perforations at 3,188-98 ft., with top of the Viola at 3,183 ft. (—1,413 ft.). This is the third completion in the pool, the second being a quarter mile north of the discovery well.

A new Kansas City lime gas pool has been found by G. T. Lackey by his 1 Manser, NW NW SE 25-31-6e, Cowley County. Located 4½ miles east of the Burden pool, the well flowed 1,180,000 cu. ft. per day after acidizing with casing perforated at 2,174-79 ft. Zone was topped at 2,470 ft. (—1,084 ft.). Hole is plugged back to 2,489 ft. from a total depth of 2,917 ft. in Mississippian, topped at 2,817 ft. Casing was run to 2,770 ft.

KANSAS SUCCESSFUL WILDCATS

Butler County: Wiedemann 1 Rombold, SW SW SW 4-26s-3e, 30 bbl. of oil per day from Mississippian, TD 2,771 ft.

Cowley County: Lackey 1 Mansur, NW NW SE 25-31s-6e, 1,180,000 cu. ft. of gas per day from Kansas City, TD 2,917 ft.

Russell County: Stearns 2 Howe, SW NW NE 16-11s-15w, 18 bbl. of oil per day from Arbuckle, TD 3,448 ft.

KANSAS WILDCAT FAILURES

Barton County: Ash 1 Klepper, NW NW SE 3-19s-11w, dry, TD 3,403 ft.

Bay 1 Buhrle, NE NE NW 36-20s-11w, dry, TD 3,358 ft.

Powell 1 Shaffer, SW SW NE 11-20s-13w, dry, TD 3,510 ft.

Raymond 1 Radenburg, NE NE NW 25-18s-11w, dry, TD 3,331 ft.

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Butler County: Rex & Morris 1 Long, SW SW SE 30-23s-4e, dry, TD 2,538 ft.
Lauck 1 Rickard, NE SW SE 8-27s-3e, dry, TD 3,164 ft.

Ellis County: Virginia 1 Weigel, NW NW NW 30-12s-16w, dry, TD 3,708 ft.
Anschutz 1 Furthmeyer, NE SE SE 19-12s-18w, dry, TD 3,924 ft.
Wilson 1 Braun, NE NE SW 26-13s-17w, dry, TD 3,542 ft.

Marion County: Adair 1 Fisher, NE SE NE 6-21s-4e, dry, TD 2,648 ft.

Morris County: Westgate-Greenland 1 Orphans Home, SE SE SE 15-16s-7e, dry, TD 2,164 ft.

Rice County: Phillips & Hansen 1 Boldt, SW SW NW 30-18s-9w, dry, TD 3,309 ft.
Ingling 1 Gray, SE SW NW 28-20s-9w, dry, TD 3,315 ft.

OKLAHOMA

Abandoned Test Reworked; Opens Hughes County Pool

HUGHES County added another new pool the past week at Coronado Oil Co. 1 Stephenson, NE NE NW 15-6n-9e, north of Atwood and 4 miles southwest of the Horn's Corner pool. The hole, originally drilled by Atlantic Refining Co. to 5,459 ft. in Wilcox and abandoned a year ago, was taken over recently by Coronado and plugged back to 2,873 ft. in the Rooch sand, top of which has been checked at 2,800 ft., and on which casing was run to 2,795 ft. The well swabbed at the rate of 75 bbl. of oil per day, and now is being put on the pump.

Completed in August as the discovery well of the East Bradley pool in Garvin County, Cities Service Oil Co. 1 Dacus, C NW SW 29-5n-4w, has been plugged back from its original producing horizon in the Bromide and McLish sands at 11,180-11,748 ft. to the Chimney Hill zone of the Hunton lime. From this zone, with casing perforated at 10,254-315 ft., it flowed 316 bbl. of oil in 6 hours through ½-in. choke, 426 bbl. in the next 24 hours through ½-in. choke, and 229 bbl. in the succeeding 24 hours through 13/64-in. choke, to establish a second producing zone. Plug-back depth is 10,390 ft. Production in the lower zones failed to hold up.

A new and deeper pay zone also has been opened in East Lindsay pool, Garvin County, by Max Pray and R. L. Bauman 1 Hinkle, C NW SW 6-4n-3w, an old well deepened from 10,217 ft. to 11,163 ft. At its former total depth, the well produced from both the Bromide and Hunton zones. The new pay is the Oil Creek sand, in which 5-in. liner, cemented on bottom, was perforated at 11,034-064 ft. From this zone, the well flowed 200 bbl. of 35° oil in 24 hours through ⅜-in. choke with a gas-oil ratio of 1,200 cu. ft. per barrel.

W. A. Delaney, Jr., has proved another new producing area in Hughes County at his 1 Mattie Logsdon, NW SE NW 2-8n-9e, which has been completed as a 32-bbl. pumper in Cromwell sand with open hole at 3,312-30 ft. It is 2 miles southeast of the Fuhrman pool.

A new pay zone, the Oswego lime, has been opened in the Northwest Midlothian pool, Lincoln County. Tokian Production Co. and Falcon-Seaboard Drilling Co. 1 Yancey, SE SE NW 26-14n-3e, plugged back from the Prue sand, and with casing perforated at 4,078-93 ft., flowed at the rate of 12 bbl. per hour. The same operators since then have plugged back their 1 Harrold, NW NW SE of the same section, and completed it in the same zone as a confirmation well. It flowed 600 bbl. in the first 24 hours. Pinched to ¼-in. choke it made 125 bbl. in the next 24 hours.

OKLAHOMA SUCCESSFUL WILDCAT

Hughes County: Delaney, Jr., 1 Logsdon, NW SE NW 2-8n-9e, pumped 32 bbl. of

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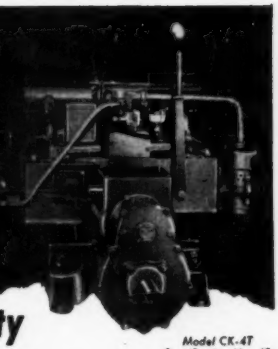

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OKLAHOMA WILDCAT FAILURES

Cleveland County: Fisher 1 Connley, C NW SE 2-10n-2w, dry, TD 6,820 ft., Hogshooter 5,328 ft., Oswego 6,310 ft., sand 6,410 ft., unconformity 6,535 ft., Woodford 6,587 ft., Misener detrital 6,597 ft., Bois d'Arc 6,607 ft.

Cotton County: Fordl Hardin, NE NW NW 26-3s-11w, dry, TD 1,611 ft., sand 910 ft. and 1,035 ft., conglomerate 1,258 ft., sand 1,490 ft. with slight show of oil.

Garvin County: Carlock 1 Moore, NW NE NW 25-1n-3w, dry, TD 2,905 ft., Sylvan 1,246 ft., Viola 1,456 ft., first bromide sand 2,448 ft., second bromide sand 2,577 ft.

Kay County: Finston & Co. 1 Scheer, SE SE NE 24-27n-1e, dry, TD 3,700 ft., Layton 2,817 ft., Checkerboard 2,954 ft., Big lime 3,146 ft., Oswego 3,273 ft., Prue 3,451 ft., Verdigris 3,487 ft., Skinner 3,523 ft., Red Fork 3,601 ft., Inola 3,699 ft.

Kiowa County: Schulte 1 Braun, SE SW SW 36-6n-18w, dry, TD 721 ft. in granite.

Lincoln County: Kemp & Harp 1 Wolf, NE NE SE 31-17n-6e, dry, TD 3,325 ft., Hogshooter 1,915 ft., Checkerboard 2,220 ft., conglomerate 2,245 ft., Big lime-Oswego 2,817 ft., Prue 2,940 ft., Verdigris 2,975 ft., lime 3,137 ft., Inola 3,266 ft., coal 3,282 ft., Bartlesville 3,285 ft., Bartlesville sand 3,305 ft.

Murray County: Carlock 1 Littleton, SE NE NE 36-1n-2e, dry, TD 2,502 ft., sand 678 ft., limy sand 814 ft., sand 1,027 ft., 1,200 ft., and 1,300 ft., no shows.

Payne County: Coronado Oil Co. 1 State "A," SW SE NE 16-18n-6e, dry, TD 3,323 ft., Hogshooter 1,828 ft., Checkerboard 2,190 ft., conglomerate 2,205 ft., lower conglomerate 2,306 ft., Big lime 2,642 ft., Oswego 2,670 ft., Prue 2,754 ft., lime 2,946 ft., no Red Fork, Mississippi lime 3,309 ft.

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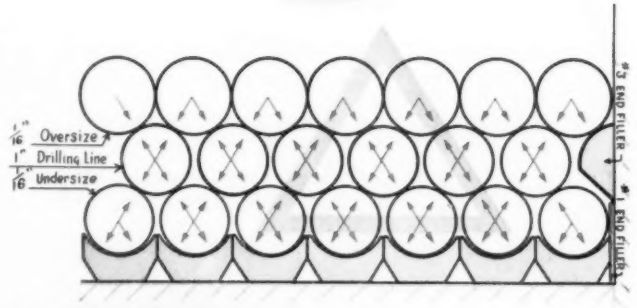

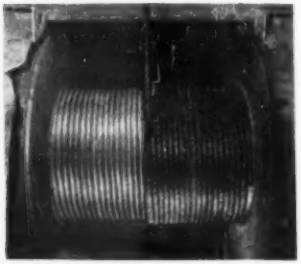

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CALIFORNIA

Russell Ranch Field Giver Western Limit

LOS ANGELES.—The failure at Richfield Oil Corp. 73-36 F. R. Anderson, NW SE NE 36-11n-28w, in the White Rock section of Russell Ranch field, gives added proof as to the western limits of production in this area. The test was drilled to 5,636 ft. So far the only production in this section is from the 1 Cuyama well of Crawford & Hiles, in the NW NW NW quarter. This well was drilled directionally to pierce the San Andreas fault and production comes from the east side of this fault.

Reports from Superior Oil Co. 67-25 Heath, SE SW 25-10n-17w, in the South Cuyama field, indicate that this well is close to the edge of production. The well produced 197 bbl. of 32°-gravity oil per day from a plugged depth of 4,600 ft., but may define a portion of the northeast limit of the field.

General Petroleum has reached a limit to the north in Calder field. Its 36-23 Calder was dry at 8,936 ft. about ¼ mile north of the discovery well, in Section 23-29s-25e.

The series of tests now under way in Orange County has resulted in two more dry holes: Amerada Petroleum's 48-8 Anaheim Comm., dry at 8,946 ft., Section 8 4s-10w; Independent Exploration's 18 Norris, dry at 5,305 ft., Section 10-6s-10w, Fairview area. A new location has been set by Independent in this section. The test is the 1 Irvine.

Formation tests have been run on the Richfield wildcat, 6 U.P. Unit, in the East Los Angeles area. Tests from the 8,794-ft. bottom to 8,770 ft. resulted in recovery of 450 ft. of oil and 3,692 ft. of salt water.

In the Coalinga Nose area of Fresno County, Barnsdall Oil will plug and redrill its 1-28 J. M. & R., 28-19s-16e, dry at 8,005 ft. 3 months ago. The site is 28-19s-16e. This is expected to be a deep test prompted by recent interest in Eocene formations. Both Texas Oil Co. and Superior Oil Co. have put down tests in this area. The Texas well, 21 S.P., about 1 mile to the north of this site, was dry at 10,550 ft. The Superior well, 1 mile to the east, reached 11,274 ft.

Continental Oil Co. dropped its Cantua Creek test, 1 S. P., bottomed at 10,324 ft. There is little information available on this test. It joins a rather long list of dry tries in this area.

In the Coleta Gas field, Pacific Lighting Corp. has completed the 4 Miller at 4,232 ft. Initial production is rated at 30,000,000 cu. ft. of gas. The 5 Miller is now rigging.

Both operations are in 20-4n-28w.

Considerable trouble with caving is slowing operations in Standard Oil's deep test, 45 Van Sicklin, in the Lost Hills area. Depth now is 14,596 ft., and attempts are being made to clean out the hole.

CALIFORNIA SUCCESSFUL WILDCAT

Kern County, Wasco field: Standard Oil Co. of California 5 Mushrush, 7-27s-24e, flowed 375 bbl. of 40°-gravity oil per day from Eocene at 15,250-15,530 ft., jet perf. 4 holes per foot at 15,250-75 ft., 15,285-15,310 ft., 15,325-50 ft., 15,365-90 ft., 15,440-75 ft., and 15,495-15,530 ft.; top Veeder (A-2) 13,072 ft., TD 15,866 ft.

CALIFORNIA WILDCAT FAILURES

Fresno County, Riverdale area: L. M. Lockhart 1-9 Allison, 9-17s-19e, dry, TD 6,905 ft., elev. 226 ft.

Kern County, Shale Hills area: John L. Senior 1 Bergman, 5-27s-18e, dry, TD 5,906 ft., elev. 1,392 ft.

South Belridge area: Pacific Western Oil Corp. 18-75 Government, 18-29s-22e, dry, TD 8,009 ft., test 5,565-5,780 ft., no recovery, elev. 461 ft.

Wheeler Ridge area: Richfield Oil Corp. 1 Telegraph Canyon, 30-11n-20w, dry, TD 3,220 ft., elev. 1,207 ft.

Orange County, Anaheim area: Amerada Petroleum Corp. 48-8 Anaheim Comm.,

8-4s-10w, dry, TD 8,946 ft., elev. 129 ft. Fairview area: Independent Exploration Co. 18 Norris, 10-6s-10w, dry, TD 5,305 ft., elev. unknown.

San Luis Obispo County, Cuyama area: Richfield Oil Corp. 1 Russell C, 4-10n-26w, dry, TD 2,748 ft., elev. 2,135 ft.

Ventura County, Montalvo area: Standard Oil Co. 1 Thorpe, 16-2n-22w, dry, TD 9,806 ft., elev. unknown.

Yolo County, Capay area: Amerada Petroleum Corp. Core Hole A, 34-10n-2w, dry, TD 2,535 ft., elev. 100 ft.

PERMIAN BASIN

Reef Production Searches Continue in Scurry County

MIDLAND.—Among first reports of new operations in Scurry County's reef limestone development were a ½-mile east outpost test on the southeast side of Diamond M field, redrilling of a shallow failure 1¼ miles west of the same field, and a Clear Fork exploration in a reef producing area.

The extension try is Lion Oil Co. 1 Clarence McLaughlin, 1,511 ft. from east and 660 ft. from south lines of Section 183-97-H&TC. Lion is also to deepen the shallow failure west of the field, which is the 1 Frank Strom, 662 ft. from south and 1,836 ft. from west lines, 198-97-H&TC. The well was drilled to 2,905 ft. in the Permian, in 1946, and the new contract is to 7,000 ft.

The Clear Fork test in Diamond M field is Hiawatha Oil & Gas Co. 7 L. M. Wilson, SE SE SW 193-97-H&TC, which is scheduled to 3,300 ft. with rotary. According to reports, surrounding wells which produce from the Canyon around 6,700 ft., have indicated production in the Permian above 3,300 ft.

In North Snyder field, Standard Oil Co. of Texas 5-2 Brown, NE NW 440-97-H&TC, Ellenburger failure, plugged back and completed from the Canyon at 6,540-895 ft., for a daily potential of 1,560 bbl. of oil through ½-in. choke. Stanolind Oil & Gas Co. 1 Whatley, Section 548, 3½ miles north of the west side of the field, was drilling in shale at 6,445 ft. C. L. Norsworthy, Jr., 1 D. D. Feldman, 11 miles east of Snyder, was drilling below 4,670 ft. in shale and lime.

Andrews County.—Magnolia Petroleum Co. 21-B E. P. Cowden, SW SW 3-A55-PSL, extended Silurian production east of Dollar Hide field. It topped the Ellenburger at 11,860 ft., drilled to 12,020 ft., then plugged back to 8,712 ft. and completed for 320 bbl. of 38°-gravity oil a day, flowing through 24/64-in. choke.

Upton County.—Wilshire Oil Co. 42-135 McElroy Ranch Co., 2 miles northeast of its 23-148 McElroy, which was a 1948 Wolfcamp discovery, was completed dry at 9,562 ft. The well was originally drilled to around 7,163 ft. From perforations in the Wolfcamp at 7,700-7,835 ft., the well swabbed and flowed up to 10 bbl. of oil an hour. Tests of perforations at 7,875-7,925 ft., and 7,925-8,160 ft. had no shows. Swabbing on perforations at 9,135-9,200 ft. recovered 35 bbl. of oil in 14 hours and 80 bbl. of oil in 18 hours. After bridging back to 8,785 ft., it was shot with nitro at 8,605-8,785 ft. With packer at 8,490 ft., it was swabbed 2 hours and kicked off to flow 77 bbl. of oil in 7 hours, and died. It was plugged back to 7,793 ft., and pumped 55 bbl. of oil in 8 hours, then 18 bbl. of oil in 12 hours, and reported temporarily abandoned.

Cities Service Oil Co. was reported as starting immediately at its 1-AD University, a 9,000-ft. rotary wildcat 15 miles north of Iraan, in SE NE 10-14 University Lands.

Humble Oil & Refining Co. 1 Ralph Pembrook, DeWitt Survey, 6 miles north of Benedum field, recovered 45 ft. of mud on a 1-hour drill-stem test at 11,944-982 ft. It drilled ahead below 12,007 ft.

Magnolia 1-36 Roy Glass, 36-41-T&P, ¾-mile southwest offset to Pegasus field, Ellenburger discovery, developed a flow from the Devonian on a drill-stem test at 11,870-11,960 ft. Gas came to the surface in 6 minutes, and oil in 2 hours and 50 minutes. It cleaned into pits, then gaged 9½ bbl. of 47.7°-gravity oil in 2 hours, cut one-tenth of 1 per cent with sediment. Gas-oil ratio was 4,781 cu. ft. Drilling will be continued to the Ellenburger.

Gaines County.—The Texas Co. 1 E. D. Harris, 17-A22-PSL, 4 miles east of Flanagan field, recovered 5,843 ft. of salt water with no shows, on a drill-stem test in the Clear Fork from 7,250-7,433 ft. It was reported ready to plug back to 6,120 ft. and attempt completion from the Glorietta section around 5,970-90 ft., where a previous drill-stem test yielded some 400 ft. of free oil.

Ralph Lowe 1-B Helen Cunningham-Stanolind Oil & Gas Co., 4-A24-PSL, south offset and second well for Doss Canyon field, flowed 301 bbl. of oil in 24 hours through ½-in. choke, from perforations in the Canyon at 8,840-8,951 ft.

Pecos County.—C. H. Murphy & Co. 1 Ford, SW NE 3-3-H&TC, 1 mile east of Abell field, developed salt water in the McKee sand section of the Simpson. Pipe was perforated at 5,462-80 ft., and swabbed. Plans were to drill ahead and test the Waddell sand.

Fullerton Oil Co., Callery & Hurt, and Peerless Oil & Gas Co. 1-D Kone, 36-3-H&TC, deep test in the northwest section of Pecos Valley high-gravity field, was to drill another 15 ft. into the Ellenburger, after recovering only a light show of oil in swabbing open hole from 7,998-8,028 ft. The well previously flowed 136 bbl. of oil in 16 hours, through ½-in. choke, from the Ellenburger at 7,971-83 ft.

WEST TEXAS (DISTRICTS 8 AND 7-C) SUCCESSFUL WILDCAT

Scurry County, 1½ mi. SE extension to North Snyder field: W. A. Moncrief et al 1 C. W. Huckabee, NE NW 160-3-H&GN, 5 mi. N Snyder, flowed natural

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WEST TEXAS (DISTRICTS 8 AND 7-C) WILDCAT FAILURES

Crockett County: A. W. Adkinson 1 L. B. Cox, 26-2-I&GN, dry, TD 1,134 ft., San Andres 1,084 ft., elev. 2,187 ft.

Dawson County: Lawson Drilling Co. 1 Alma Gaines, NW SW 15-C39-PSL, 1½ mi. NW Welch, 1,320 ft. E of Tide Water 1 Turner, extension to Welch field, dry, TD 4,940 ft.

Garza County: P. W. Anderson 1 R. Clyde Miller "A," 41-6-H&GN, 3 mi. SW Justiceburg, dry, TD 2,617 ft., anhydrite 590 ft., San Andres 2,093 ft., elev. 2,351 ft.

Upton County: Wilshire Oil Co. 42-135 McElroy Ranch Co., SE NE 135-E-CCSD&RGNG, 4½ mi. E McElroy field, dry, TD 9,562 ft.

SOUTHEASTERN NEW MEXICO

HOBBS.—In Chaves County, 15 miles east of Roswell, Buffalo Oil Co. 3 Comanche Unit, SW NW 26-11s-26e, was reaming in dolomite at 6,061 ft., total depth. On an elevation of 3,669 ft., base of the Pennsylvanian was reported at 5,935 ft.

The bottom 3 ft. of a core from 5,938-43 ft. was dolomite having good porosity and saturation, and a drill-stem test from 5,935-50 ft., open 18 minutes, had gas in 1 minute, estimated at 3,000,000 cu. ft. daily, and recovered 240 ft. of gas-cut mud having a trace of distillate. Flowing pressure was 570 psi. A 10-ft. core from 5,950-60 ft. recovered dolomite with cavernous porosity and bleeding oil and salt water on fracture. A 43-minute test from 5,935-60 ft. had gas in 3 minutes and recovered 90 ft. of gas-cut mud, 820 ft. of salt water-cut mud, and 180 ft. of salt water. Flowing pressure was 410 psi. A 75-minute test at 5,971-94 ft. produced only a good blow of air and recovered 450 ft. of drilling mud plus 3,270 ft. of salt water.

In Eddy County, Humble Oil & Refining Co. 1 Wiggs, 31-24s-27e, was drilling below 11,287 ft. in lime and chert.

Humble 1-X State, 31-11s-35e, Lea County, was plugged back to 9,700 ft. from 13,228 ft., total depth. Operators were fishing for casing after setting plug.

McAlester Fuel Oil Co. 1 J. M. Denton, Wolfcamp or Pennsylvanian and Devonian discovery, 14 miles northeast of Lovington, in 11-15s-37e, was running casing to complete. Total depth was 11,417 ft.

A drill-stem test from 11,264-367 ft., open 4 hours and 40 minutes, flowed oil in 1 hour and 55 minutes; flowed into pits for 45 minutes, then gaged 40 bbl. the first hour and 25 bbl. of oil the second hour. Gravity of the oil was 44.5°. Flowing pressure was 3,340 psi.

A 4-hour test from 11,265-317 ft. showed a small amount of gas in 2 hours and 15 minutes, and recovered the water blanket, plus 480 ft. of heavily oil and gas-cut mud, and 3,060 ft. of oil. Flowing pressure was 1,435 psi.

The well had previously showed for commercial production of 45°-gravity oil, from either Wolfcamp or Pennsylvanian, at 9,499-9,536 ft.

Southeast of the discovery, Atlantic Refining Co. 1 Dickinson, 13-15s-37e, was drilling below 6,785 ft.

The Texas Co. 1 Ertel, 27-16s-38e, 2 mile northwest outpost to the Knowles Devonian field, was drilling ahead at 4,490 ft.

SOUTHEAST NEW MEXICO WILDCAT FAILURES

Chaves County: Union Oil Co. of California et al 1 State, NE SW 27-11s-27e, dry, TD 7,582 ft., San Andres 1,390 ft., Glorietta 2,585 ft., Abo 4,993 ft., Pennsylvanian 5,740 ft., detrital 6,630 ft., Mississippian 6,710 ft., Devonian 7,016 ft., pre-Cambrian 7,566 ft., elev. 3,791 ft.

Lea County: York & Harper, Inc., 1 Bill Rieker, SW SE 17-22s-34e, dry, TD 5,000 ft., anhydrite 1,650 ft., Yates 3,906 ft., reef 4,310 ft., elev. 3,483 ft.

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MISSISSIPPI

Danciger Having Trouble In Completing Discovery

JACKSON. — Difficulty is being encountered in completing the Danciger Oil & Refining Co. 1 Mrs. Kate S. Logan, discovery well for the Rodney field, Jefferson County, Mississippi. Drill-stem test was made with packer set at 9,437 ft., and first gas was noted at surface after tool had been open 15 minutes, with maximum surface pressure at 17 psi. after tool had been open 40 minutes. Pressure then dropped until levelling off at 4 to 5 psi. Operators closed testing tool and started pulling tubing, and after seven stands had been pulled, fluid started unloading from tubing. Estimated recovery was 20 bbl. of 38°-gravity oil and 43 bbl. of salt water. Operators will cement off open hole 9,457-59 ft. and attempt completion at 9,400-10 ft. from the Tuscaloosa sand.

In Adams County, Mississippi, Sohio Petroleum Co. 1 T. B. Buckles, wildcat, 18-8n-3w, cored in the Wilcox at 5,355-71½ ft. with recovery being shale with a streak of lignite. Recovery from core at 5,371½-75½ ft. was 1 ft. of porous salt-water sand. Operators will drill ahead to 6,500 ft.

Red Wing Drilling Co. has set surface pipe at the 1 Torry Smith, wildcat, 32-10n-11w, 6 miles northeast of Laurel, Jones County, Mississippi. The test is in an area where uncommercial shows of oil and gas have been logged in two previous wildcat trys.

In Walthall County, Mississippi, California

Co. is running casing in the 1 Mrs. Cora L. Collins et al, 2-3n-11e. Total depth is 1,841 ft.

Humble Oil & Refining Co. is taking sidewall cores at 11,159 ft., in the 1 Laura Butler, 15-5n-3w, Adams County, Mississippi.

Tricon Minerals, Inc., is moving in material to drill the 1 H. B. Gilbert, wildcat in the 14th Land District, Lot 266, Houston County, Georgia.

The six new locations in Mississippi include one wildcat start in Washington County. There were no exploratory wells completed during the week in Mississippi, Florida, Georgia or Alabama.

CANADIAN FIELDS

New Group of Test Wells Start in Alberta

CALGARY.—Rio Bravo Oil Co., Ltd., Canadian subsidiary of Superior Oil Co. of California, is starting its first wildcat in Alberta. Reo Bravo-Ronald No. 78-6 is located in LSD 1, 6-38-15w4, about 3 miles southeast of Halkirk town, 27 miles due east of Stettler Devonian oil discovery, and 8 miles west of the Castor gas discovery.

Seven new exploratory tests, in addition to the Rio Bravo venture, were staked in Alberta this past week. They are spread over the province from as far south as 1½ miles north of the American border, to some 65 miles north of Edmonton.

The southernmost wildcat is being drilled jointly by Union Oil Co. of California and National Petroleum Co. of Calgary, at Del Bonita, near the Montana border, 45 miles due south of Lethbridge, and will be primarily a test of Madison limestone oil and gas possibilities. Completion depth is expected to be around the 5,000 ft. level, but the hole may be carried down to the Devonian.

Royalite Oil Co. of Calgary is moving in a rotary rig to the Consort area, about 150 miles northeast of Calgary. The venture will be drilled on the company's own reservation in this region, and will test all horizons down to and including the Devonian.

In addition to the Del Bonita test, Union Oil of California has commenced drilling on an Imperial farmout in northern Alberta. The well, located near Picardville, is about 40 miles northwest of Edmonton.

The Barnsdall-Honolulu-Seaboard group, starter operations at its second wildcat test in the Smoky Lake area, about 50 miles, northeast of Edmonton. This second venture, around 6 miles from the team's initial wildcat abandonment, will also test Devonian prospects down to around 3,300 ft.

Stanolind Oil & Gas Co. has staked its eighth exploratory well this year. Slated as a stratigraphic test for subsurface information, it will go down to the Devonian. It is situated in the Pine Creek area, around 65 miles north of Edmonton.

Western Prairie Exploration Co., Canadian subsidiary of Woodley Petroleum Co. of Houston, is starting a test on a 4,960-acre farmout from Socony-Vacuum Exploration Co. The well, at Endiang, about 100 miles northeast of Calgary, will test the Cretaceous, Madison, and Devonian formations.

Anglo Canadian Oil Co. of Calgary is starting a new test at Elk Point, about 55 miles northwest of the Lloydminster oil field. With Viking and Lower Cretaceous gas discoveries and Devonian salt production in the region, Anglo will explore all these horizons for oil and gas possibilities.

Six field development wells completed drilling this week, five at Redwater and one at Leduc. All were successful and placed on steady production. At Redwater, Western Leaseholds, Ltd., of Calgary placed

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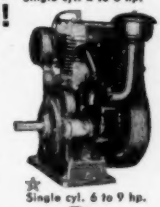
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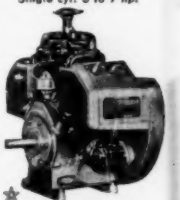
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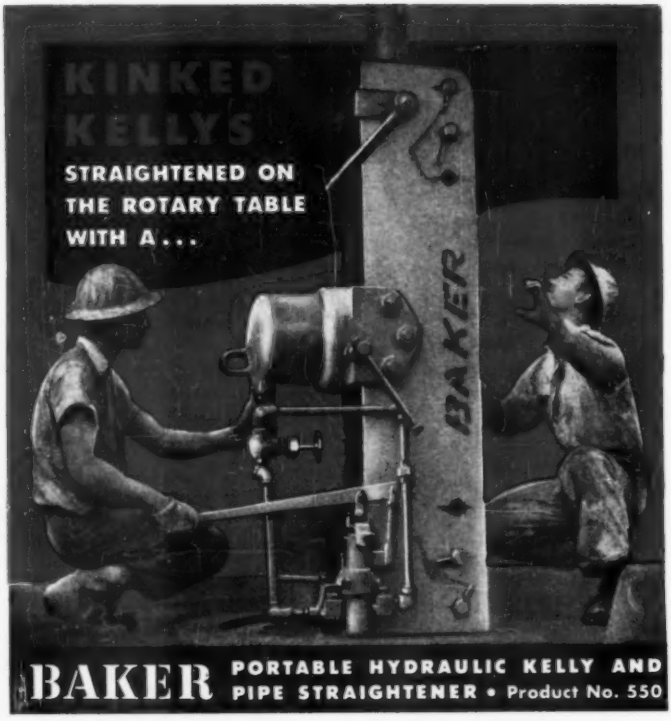

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its 38th well on production; Amerada Petroleum Corp. started its seventh and eighth successes flowing; and the Texaco-McColl team and Imperial Oil each started one well on production. At Leduc, Imperial Oil completed one additional successful oil well.

CANADIAN WILDCAT FAILURES

Bear Mustang No. 1, LSD 4, 9-65-18w4, TD 3,585 ft.

Woodbend Devon-Carbondale No. 1, LSD 7, 10-55-24w4, TD 5,000 ft.

Fort Augustus No. 1, LSD 13, 6-55-22w4, TD 4,721 ft.

Central-Del Rio No. 1, LSD 15, 26-50-1w5, TD 6,500 ft.

Vilna Time No. 1, LSD 5, 12-59-13w4, TD 3,000 ft.

ILLINOIS

Active Development Starts In New Edgar County Field

MATTOON. — The new McClosky lime pool opened in the Eldridge area, southeastern Edgar County, by National Associated Petroleum Co. already is getting an active development play with three confirmation wells in process of completion and two others drilling.

National Associated Petroleum Co. 1 Mason-Cockcroft Community, SW SW NW 1-12n-11w, north offset to the discovery well (1 Harlan Cockcroft, NW NW SW 1-12n-11w), swabbed 110 bbl. of oil per day natural from the pay at 987-92 ft. with casing at 986 ft.

The same company's 1-B Maddock, NE NE SE 2-12n-11w, west offset to the discovery well, flowed 140 bbl. per day through 47/64-in. choke with pay at 948-53 ft. (total depth 958 ft.).

No. 1 Elliott-Lukken-Mason Community, SE SE NE 2-12n-11w, a south offset to the Maddock well and a southwest diagonal offset to the discovery well, has run $5\frac{1}{2}$-in. casing at 976 ft. to test the zone at 978-85 ft. In a drill-stem test at 966-80 ft., a recovery of 240 ft. of free oil and 90 ft. of muddy oil was obtained.

In final production tests the past week, the discovery well pumped at the rate of 50 bbl. of oil and 50 bbl. of water per day. The latter produces through casing perforations at 969-73 ft. and 978-82 ft. Currently drilling are National Associated Petroleum Co. 2-B Maddock, SW NE SE 2-1n-11w, west offset to the Elliott-Lukken-Mason well, and Ryan Oil Co. 1 Fred Swank, SE SW NW 6-12n-10w, a little over a mile to the east of the discovery well.

A $\frac{3}{4}$-mile extension of production of the Olney field in Richland County is indicated at W. E. Weidler and Paul Doran 1 Boudeman, NW NW SW 14-4n-10e, which flowed clean oil in a drill-stem test of McClosky lime at 3,020-23 ft. Gas showed in 5 minutes after the tool was opened and oil in 40 minutes. Casing has been run to 3,010 ft.

A new pay zone for the Aden Consolidated pool, Wayne County, is in prospect at H. H. Weinert 5-B Morlan, SE NE NW 33-2s-7e, where $4\frac{1}{2}$-in. liner has been cemented to test the Osage (Mississippian) at 4,132-37 ft. A strong show of gas, which blew mud out of the hole, was encountered in drilling the Osage. The well previously was completed in the Salem lime at 3,737-47 ft., where it pumped 18 bbl. natural. Present producing horizons in the field include the Aux Vases, Lower O'Hara, Rosiclare, McClosky, and Salem.

Bell Brothers 1 Porter-Seiler Community, NW NE SE 3-4n-10e, which opens a new producing area $1\frac{1}{2}$ miles southwest of the East Dundas pool, 6 miles north of Olney, Richland County, has been completed on the pump for 81 bbl. per day from O'Hara lime at 2,986-91 ft. (total depth 3,018 ft.). It previously swabbed at the rate of 14 bbl. per hour.

ILLINOIS SUCCESSFUL WILDCATS

Edgar County: National Associated Petroleum Co. 1 H. S. Cockcroft, NW NW SW 1-12n-11w, IP 50 bbl., McClosky 969-73 ft. and 978-82 ft., TD 2,093 ft. (Discovery well Eldridge pool.)

Gallatin County: Oil Management Co. 1 Doumen, SE SW NE 7-8s-10e, IP 76 bbl., Tar Springs 2,127-34 ft., TD 2,145 ft. (Extension Inman Central pool.)

Jasper County: F. Lomelino 1 Ochs, C NW NE 27-6n-10e, IP 69 bbl., McClosky 2,806-20 ft., St. Louis 2,902-06 ft., and Devonian 4,345-59 ft. and 4,394-4,402 ft., TD 4,515 ft. (Extension Clay City-Noble Consolidated pool.)

Richland County: Bell Brothers 1 Porter-Seiler, NW NE SE 3-4n-10e, IP 81 bbl., Lower O'Hara 2,986-91 ft., TD 3,018 ft. (Opens new pool.)

ILLINOIS WILDCAT FAILURES

Coles County: Lamb-Boyd & Brown 1 Buskart, SE SW SE 7-12n-14w, dry, TD 511 ft.

Jasper County: N. C. Davies 1 Jenkins, NW SW NE 18-5n-11e, dry, TD 3,034 ft.

Lee County: H. O. Carr 1 Vedovell, NW NE NE 35-20n-10e, dry, TD 3,652 ft.

Macoupin County: Dale E. Lambert 1 E. R. Smith, NW NW NE 13-9n-7w, dry, TD 554 ft.

Madison County: George Cassens 1 Blackburn, SW SE NE 21-5n-7w, dry, TD 669 ft.

SOUTH LOUISIANA

Texas Co. Opens New Pay Sand in Fordoche Field

NEW ORLEANS.—A new pay sand has been opened in Fordoche field, Pointe Coupee Parish, by The Texas Co. 3 J. O. Long et al. Through perforations at 8,798-802 ft., the well flowed 155 bbl. of 38.5-gravity oil per day through 9/64-in. choke. Total depth of the well is 9,600 ft.

Magnolia Petroleum Co. is testing gas in the 3 Abel West Heirs, wildcat 4 miles northeast of the 1 West discovery at Holly Beach, Cameron Parish. Through a 12/64-in. choke, the well flowed 500,000 cu. ft. of gas daily through perforations at 10,690-700 ft. with tubing pressure at 550 psi. Total depth of the well is 12,338 ft., with 7-in. casing at 11,675 ft.

Superior Oil Co. 1-A State Lease 1164, Gulf of Mexico, tested 3,500 M.c.f. gas per day on drill-stem test at 7,150-60 ft. This is the second drill-stem test made on the well. An earlier test of perforations at 7,730-38 ft. had no shows. Operators will continue to test the prospect.

In Acadia Parish, 5 miles south of Eunice, P. A. Ward brought in the 1 Winnifred B. Vincent, 14-7s-1w, for an estimated daily gage of 60 bbl. of oil through a 10/64-in. choke. The discovery is approximately 2 miles due east of Ritchie oil field. The well is flowing under a tubing pressure of 150 psi. from perforations at 3,681-86 ft., deeper sands than those producing in Ritchie field. Ward is staking locations for a confirmation test to the well 660 ft. due west of the discovery, which will be the 2 John Wilfert.

H. L. Hunt has made a drill-stem test on the 1 State Lease 1689, Mallard Bay wildcat in Cameron Parish. Seven-inch casing was perforated at 9,119-23 ft. and recovery was 3,000 ft. of water cushion and salt water with 250-psi. pressure and 3,225-psi. bottom-hole pressure. Operators have squeezed these perforations and are continuing to test the venture.

The 13 new locations in South Louisiana include 3 wildcat starts, 1 each in Iberville, Jefferson, and Rapides parishes. There was one successful exploratory test completed in Pointe Coupee Parish.

SOUTH LOUISIANA SUCCESSFUL WILDCAT

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OHIO, KENTUCKY

Perry County Wildcat Completed as Gasser

COLUMBUS.—Indications of a gas pool were found in Hopewell Township, Perry County, by a wildcat drilled in by David Shafer on 1 F. H. Coble, Section 11, Clinton was topped at 2,938 ft. and drilled to 2,964 ft., where the gage was 1,870,000 cu. ft. The well is to be tubed without shooting or further drilling.

The first oil production in Clay Township, Knox County, was found by C. O. Moore et al on 1 G. K. Schooler, Section 12, 1 mile north and 2 miles east of the old Mt. Vernon gas field. Clinton at 2,811-32 ft. had a good showing natural and made 40 bbl. in 24 hours after a 100-qt. shot.

Another pool opener in Jackson Township, Knox County, was brought in by Sheffield Oil Co. on Jacob Burch, Section 19. Clinton at 3,055-92 ft. filled 500 ft. while drilling in and made 87 bbl. the first day after shot.

The Midland Oil 2 Wm. Bratton, Lot 24, Hopewell Township, Licking County, logged the Clinton at 2,842-84 ft. and flowed 40 bbl. after shot. The company has staked an offset to the west on Sarah Gutridge in Lot 25.

William Larrick will deepen the 1 E. R. Woodard, Lot 11, Oxford Township, Tuscarawas County, a dry hole in the Berea sand, and test the Oriskany.

Thirty locations from 14 counties were reported for the week. Ashland led with 7, while Meigs had 5, Perry 4, and Athens 3. Ashland field led in completions with 7 out of a total of 19.

OHIO WILDCAT FAILURE

Stark County, Bethlehem Township: Ed Obermiller et al 1 F. D. Thompson, Section 21, Clinton 4,297-4,366 ft., TD 4,427 ft.

EASTERN KENTUCKY

ASHLAND.—In Cumberland County, 9-C-50, and near the town of Burkesville, Collie Ellis et al 1 Merley is drilling ahead at 500 ft. The test is located on the Meshack uplift and will probe lower Ordovician and possibly Cambrian formations.

In Johnson County, 19-R-79, some 12 miles northwest of Paintsville, Ashland Oil & Refining Co. is drilling slowly ahead at 5,661 ft. Considerable trouble has been experienced in keeping straight hole on this test but apparently difficulties have cleared up as drilling has been resumed.

In Morgan County, 4-P-76, and on the northeast extremity of the old Cannel City pool, Earl McClure et al are drilling below 950 ft. on 1 Lige Vance, a test designed to pick up production in the Corniferous lime which produced for some years in the old wells to the southwest.

EASTERN KENTUCKY WILDCAT FAILURE

Powell County: Arch Carpenter et al 1 James Hall, 8-P-67, dry, TD 6,088 ft., Corniferous 88 ft., Brassfield 165 ft., Tyrone 1,106 ft., St. Peter 1,765 ft., Knox 1,783 ft., Cambrian sand 5,143 ft., no commercial shows.

WESTERN KENTUCKY

OWENSBORO.—A rank wildcat in the extreme southwestern corner of Henderson County is giving indications of opening a new producing area. It is J. T. Peck and associates 1 Barnett heirs, 6-N-22, which, in tests of Jackson sand at 2,242-56 ft., swabbed at the rate of 3 bbl. per hour. This is an old hole, abandoned in October 1947 at a total depth of 2,745 ft. Going back into the hole, present operators cemented 7-in. casing at 2,240 ft. and gave the pay zone a 20-qt. shot. A previous drill-stem test got a good showing of gas and recovered 30 ft. of free oil and 90 ft. of mud. The well is about 6 miles west of Poole and 3 to 4 miles southwest of production in the Dixie area.

I. W. Hartman and Calvert-Willis, Inc., 1 Meredith, 11-P-18, Union County, prospective pool opener on the east side of Wabash Island, in the Ohio River, swabbed at the rate of 30 bbl. of oil daily in retesting Cypress sand at 2,308-45 ft., apparently having shut off water which broke in during initial tests. Pumping equipment is being installed for further tests. Original total depth is 2,797 ft. in McClosky lime, which failed to show production. Hole was plugged back to 2,345 ft. with 5½-in. casing at 2,410 ft. Cypress was tested through casing perforations.

Sinclair Oil & Gas Co. 1 Hite, 13-P-20, new pool opener 3 miles northeast of Uniontown in Union County, has increased its production following a 2,000-gal. acid treatment. Previously reported as flowing 240 bbl. of 39° oil daily in the first 24 hours, it has been placed on the pump and started off pumping and flowing at the rate of 14 bbl. per hour. Pay zone is the Lower O'Hara at 2,526-30 ft.

WESTERN KENTUCKY SUCCESSFUL WILDCAT

Union County: Sun Oil Co. 2-A H. C. Reisinger, C S½ NW NW 3-N-19, IP 230 bbl., McClosky 2,580-86 ft. and 2,588-2,604 ft., TD 2,608 ft. (Extension Morganfield South pool.)

WESTERN KENTUCKY WILDCAT FAILURES

Union County: The Texas Co. 1 O'Nan, SE NE SE 1-M-19, dry, TD 3,124 ft.

Wasson Oil Co. 1 Collins, C S½ NW SW 23-O-18, dry, TD 2,670 ft.

INDIANA

EVANSVILLE.—The prolific and steadily expanding Spencer pool in Posey County is being extended ¾ mile southwestward by C. E. Skiles in his 1 Vogel-Spencer, NE NW NW 14-8s-14w. In a 30-minute drill-stem test of the pool's McClosky lime pay zone at 2,883-86 ft., gas showed in 17 minutes, and 590 ft. of clean oil and 110 ft. of oil-cut mud was recovered, indicating a good well. Casing has been run through the interval to the bottom of the hole at 2,907 ft.

Lohmann & Johnson and associates 1 Stewart, NW NE NE 14-1n-8w, Pike County, a westward extension to the new Arda pool, has been completed as a 10-bbl. pumper following a 3,500-gal. acid treatment in Aux Vases sand at 1,231-61 ft. Total depth is 1,370 ft.

The recent discovery of a shallow Pennsylvanian sand pool in 11-8n-11w, Sullivan County, has been confirmed by A. J. Slagter in his 1 Leonard Bostick, NE NE SW of the section, a west offset to the discovery well, 1-A Kelly. The new well was completed for a 20-bbl. pumper in the sand at 586-615 ft. The discovery well, drilled by the same operator, made a 22-bbl. pumper at 508-606 ft. The pool adjoins a shallow gas producing area but is 5 miles from nearest oil production.

INDIANA WILDCAT FAILURES

Gibson County: Aurora Gasoline Co. and N. V. Duncan 1 Harbison, NW NW SW 8-2s-9w, dry, TD 1,798 ft.

Posey County: Sohio Petroleum Co. 1 M. E. Smith, SE SW SE 21-4s-12w, dry, TD 2,904 ft.

Sullivan County: C. E. Skiles 1 C. Bedwell, NE NW NE 18-7n-8w, dry, TD 2,460 ft.

Vigo County: G. H. Froderman 1 Gramer Comm., SW SW NW 25-12n-9w, dry, TD 1,723 ft.

Improved Drilling Techniques Needed

(Continued from page 135)

Harrigan of Standard Well Servicing Co., Oklahoma City.

H. L. Rowley of Big Chief Drilling Co., Shreveport, was chosen again to be vice president for Cretaceous and Tertiary basins, and Zach Brinkerhoff, Jr., for another term as vice president for Rocky Mountains. Louis A. Beecherl of McDaniel & Beecherl Drilling Co., Dallas, was slated to be returned as association treasurer, and Brad Mills and J. Doyle Settle were chosen to continue as executive vice president and treasurer, respectively.

"The Balanced Rotary Rig" was discussed by C. H. Oberg, Standard Oil Co. of California, Taft, Calif., in the Tuesday morning session. In obtaining a balanced rig, he stated, the first problem is to establish the power requirements involved in the performance of the two basic functions of drilling, which involves rotating the drill pipe and circulating the drilling fluid, and of hoisting and lowering the drill pipe. The second problem facing the contractor involves use of this information in establishing the distribution of horsepower to suit a particular set of conditions. After these requirements are met, consideration should be given to the equipment to make certain each part is balanced to the power available and to the work to be performed.

The best economy for a particular type of drilling he believed is obtained by combining good drilling performance with high mechanical efficiency. Most complete rig assemblies that are balanced to suit particular conditions have a limited range of economical drilling depth, and must be modified to suit a substantially different set of conditions . . . "far more caution is necessary in balancing the parts of a rig for deep drilling than for shallow drilling operations." In concluding he stated that selection of drill-pipe size to give the most desirable balance between hydraulic efficiency and ton-mile service is felt to be the major problem in obtaining a balanced rig for deeper drilling.

Marshall Is Speaker

The response to Oberg's paper was given by R. W. Marshall, vice president and general manager of Drilling & Exploration Co., Inc., Los Angeles. He agreed that such balancing of rigs is highly desirable but believed the great increase in efficiency achieved by contractors in the past several years has been largely due to their efforts to improve drilling techniques—better planning in making proper selection of bits, drill collars, weight on bit, rotating speeds, and better supervision. In Marshall's opinion the latter is perhaps one of

the largest single factors and attributed the much faster drilling rates, lack of fishing jobs, etc., almost entirely to supervision.

Following Marshall's address Hamilton Rogers, Rowan Drilling Co., Fort Worth, presented "The Drilling Contract." (See page 160.) The operator's response to this paper was given by Earl A. Brown of Magnolia Petroleum Co., Dallas. Most of Brown's address dealt with "hold harmless" clauses and contractual insurance, and efforts to standardize the former and to reduce rates for the latter when applied to underground damage. He was hopeful that conditions may develop by which coverage for underground damage may finally be secured at reasonable rates.

"Rig to Office Communications" was given by C. J. Paine, president of Paine Drilling Co., Dallas, and Jerry Stover, communications consultant of Dallas. The first portion of the address dealt with radio communications for the drilling industry, the speaker citing numerous specific examples of advantages to be gained by direct contact between the office, or automobile, and the rig. The second portion outlined the elements of a two-way radio system and discussed some of the problems encountered under actual operating conditions in the oil field, and their solution. The authors said that installed cost of a system consisting of four cars, five rigs, and an office station is as little as about $10,000.

Further Study Needed

The field in which further study and work can be done to decrease the loads on present drilling equipment or increase its depth capacity was covered in an outstanding paper, "Selecting the Drill Stem," by Bruno Schabarum and Stanley Moore. The former is with Carl B. King Drilling Co., Midland, while Moore is with Drill Collar Service Co., Midland.

Among the topics covered in the address were hoisting requirements, hydraulic efficiency, the effect of drill-pipe size on bottom-hole pressure, and the utilization of larger-bore drill collars. In regard to the latter topic it was pointed out that losses in weight, due to increasing the bore, are small compared to the benefits obtained. In discussing the hydraulics factor it was stated that:

"As wells become deeper the factor of hydraulic efficiency becomes increasingly important, because a greater percentage of the available pumping capacity is expended in overcoming losses down the drill-stem bore and up the well-bore annulus. . . . Today, losses attributable to the drill stem, including drill collars, usually amount to 80 to 90 per cent of the total pump pressure... If the comparatively new technique known as "jet drilling" is to be effectively used, attention must be given to the hydraulic efficiency of the circulating system."

To illustrate the importance of design for hydraulic efficiency the following example was offered: "In selecting drill collars, how much thought do you give to the difference between 2-in. and 2¼-in. bore? It is only ¼ in., but if you are a West Texas operator, running 20 drill collars and circulating 250 gal. per minute, it means 15 to 25 per cent difference in the efficiency of your entire pumping operation. Think of the significance of this in terms of equipment, maintenance, and fuel costs."

Two other papers presented at the meeting were "Diamond Core Bits," by R. B. McCloy of Stanolind Oil & Gas Co., Tulsa, and "Hydraulic Power Transmitters," by Nicholas A. D'Arcy, Jr., Huntington Park, Calif. *(A portion of the latter's paper is given on page 206.)*

In the annual banquet slated for Wednesday night Texas' Governor Shivers was to be the principal speaker, with Howard P. Holmes of Two States Drilling Co., Dallas, presiding. In the Tuesday noon luncheon N. H. Wheless, drilling contractor of Shreveport, presided and J. L. Hamon of Cox & Hamon, Dallas, was the guest speaker. Joseph S. Morris, retiring association president, presided at the installation of new officers at the Tuesday luncheon.

Shivers Throws Hat in 1950 Governor's Race

AUSTIN.—Gov. Allan Shivers announced in Mexico City last week that "God willing and the people favorable" he will be a candidate for governor in next year's primaries.

Shivers stepped into the governor's chair several months ago as the result of the death of Beauford H. Jester. Atty. Gen. Price Daniel, Railroad Commissioner Olin Culberson, and State Land Commissioner Bascom Giles were all considered probable gubernatorial candidates prior to Jester's death. Currently, it is considered by capital observers that Culberson is the only certain candidate of the three.

Gas Price-Fixing Case Is Taken Under Advisement

District Judge Ray H. Calihan, Garden City, Kans., has taken under advisement a case wherein three major natural-gas pipe-line companies are attacking the right of Kansas Corporation Commission to use well-head price fixing as a means of conservation in the big Hugoton gas field.

The firms had brought suit against the commission declaring the action of fixing an 8 cents minimum price per 1,000 cu. ft. of gas at the well head has no legal basis. The companies' attorneys maintained the commission's action is in opposition to Federal Power Commission authority.

The state argued that while it does not have explicit price-fixing authority, it merely uses price fixing as a tool for conservation. Decision is expected to be appealed to the Kansas Supreme Court, and possibly to the U. S. Supreme Court.

22.3 Per Cent of Nation Gets Livelihood From Oil

NEW YORK.—Of the total United States population, 22.3 per cent is directly dependent on oil for its livelihood.

The figure was contained in the results of a survey conducted by the American Petroleum Institute. The oil industry itself employs 1,880,000 persons, the A.P.I. said, and another 7,915 persons are employed by industries directly related to the petroleum industry. These workers and their families include 34,282,000 persons.

The A.P.I. industry by industry breakdown follows:

Petroleum and its products	1,880,000
Petroleum equipment	120,000
Automotive manufacturers	757,000
Automotive services	1,311,000
Aircraft manufacturers	183,000
Commercial airlines	61,300
Oil burner manufacturers	15,000
Oil burner dealers and services	28,500
Motor boats and outboard motors	8,000
Motorcycle manufacturers	6,000
Tractor and power-driven farm machinery	135,600
Motor truck transportation	5,014,000
Bus transportation	232,000
Other directly related services	43,600
Total	9,795,000

Senator Orders Study Of Heating-Oil Prices

WASHINGTON. — Sen. Burnet R. Maybank of South Carolina this week ordered the staff of his banking committee to investigate the recent increases in prices of fuel and heating oils.

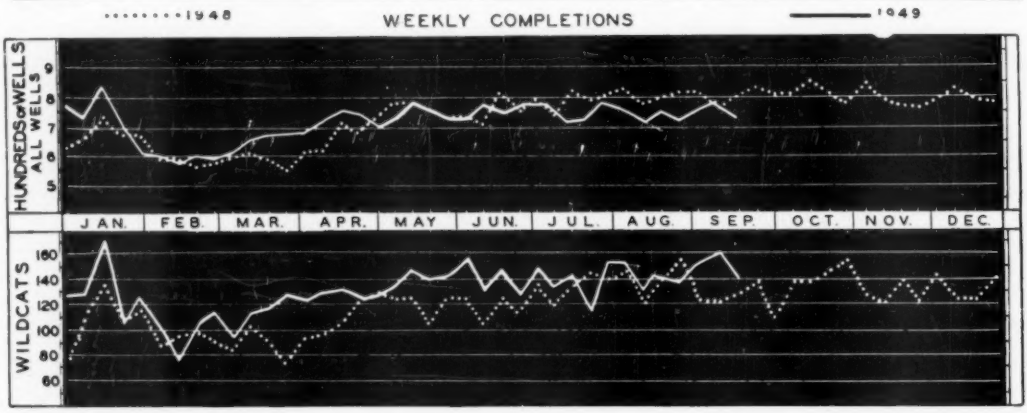
Maybank said the increases are being justified on the ground the spread between gasoline and oil prices must be narrowed if refiners are to be encouraged to produce more heating oil for the winter season, but asserted that the proper way to deal with that situation would have been to reduce gasoline prices.

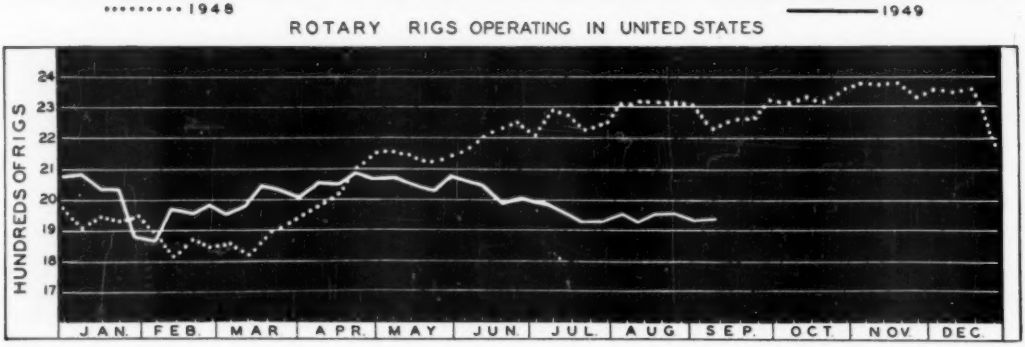
The senator assailed the allegedly high earnings of the oil companies, asserting that current estimates of this year's profits indicate they will be considerably higher than in 1947, which was second only to last year.

WEEKLY WELL COMPLETIONS . . . WEEK ENDED SEPTEMBER 17, 1949

	Total of all wells					37 wk.		Wildcat completions and discoveries					Cumulative total, 1949				
	Comp.	Oil	Gas	Dry	Footage	1949	1948	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York	15	8	0	*7	18,290	691	1,063	0	0	0	0	0	0	0	0	0	0
Pennsylvania	21	6	7	†8	38,390	1,023	1,806	0	0	0	0	0	0	0	4	1	5
West Virginia	17	6	9	2	58,149	350	577	0	0	1	1	2	1	0	11	8	20
Ohio	19	5	5	19	38,348	752	950	0	0	0	0	0	1	0	2	25	28
Indiana	27	13	0	14	47,557	920	746	0	0	0	4	4	25	0	2	168	195
Kentucky	28	8	8	12	58,978	657	500	1	0	0	3	4	21	0	0	54	75
Illinois	57	28	0	29	135,478	1,306	1,652	4	0	0	5	9	48	0	1	308	357
Michigan	26	8	3	§15	62,005	704	575	1	0	0	10	11	21	0	3	215	239
Kansas	58	29	9	20	186,040	2,248	2,155	2	0	1	13	16	53	0	6	286	345
Neb., Mo., Iowa	0	0	0	0	0	16	5	0	0	0	0	0	1	0	0	11	12
Oklahoma	82	55	3	24	287,295	3,023	2,880	1	0	0	8	9	101	11	12	446	570
Texas	235	133	8	94	997,934	9,348	8,222	8	1	3	50	62	296	38	86	1,629	2,049
North Central (Dist. 7-B & 9)	79	36	1	42	221,278	3,144	2,575	5	0	1	21	27	139	0	12	643	794
West (Dist. 7-C & 8)	56	46	0	10	288,718	2,240	2,233	1	0	0	4	5	39	0	3	184	226
Panhandle (Dist. 10)	7	6	0	1	21,470	684	422	0	0	0	0	0	1	0	0	8	9
Eastern (Dist. 5, 6, & 6-P)	16	9	1	6	62,360	486	380	0	0	0	2	2	8	4	3	109	124
Gulf Coast (Dist. 2 & 3)	43	22	5	16	251,216	1,411	1,319	1	1	1	8	11	59	27	38	279	403
Southwest (Dist. 1 & 4)	34	14	1	19	152,892	1,383	1,293	1	0	1	15	17	50	7	30	406	493
Louisiana	50	29	12	9	201,531	1,606	1,584	1	0	0	1	2	43	14	4	146	207
Northern	40	23	11	6	108,564	945	1,055	0	0	0	1	1	3	2	0	65	70
Southern	10	6	1	3	92,967	661	529	1	0	0	0	1	40	12	4	81	137
Arkansas	9	2	0	7	20,799	228	202	0	0	0	4	4	3	0	0	51	54
Mississippi	2	1	0	1	11,628	243	287	0	0	0	0	0	4	1	1	74	80
Southeastern States	0	0	0	0	0	36	40	0	0	0	0	0	1	0	0	30	31
Montana	25	15	5	5	42,338	190	192	0	0	0	1	1	3	0	2	24	29
Wyoming	7	2	0	5	32,405	428	375	0	0	0	2	2	19	0	0	84	103
Colorado-Utah	4	1	1	2	15,973	110	163	0	0	0	2	2	2	0	0	46	48
New Mexico	7	4	0	3	32,985	354	423	0	0	0	2	2	10	0	2	36	48
California	43	31	1	11	202,003	1,853	2,033	1	0	0	9	10	28	0	6	326	360
Total United States	732	384	71	277	2,488,126	26,586	26,430	19	1	5	115	140	681	64	142	3,968	4,855
Total previous week	793	435	67	291	2,900,602	25,854	25,628	21	3	6	130	160	662	63	137	3,853	4,715
Total September 18, 1948	802	433	60	309	2,762,100			12	0	5	111	128	627	53	185	3,489	4,354

Service wells included: *7, †6, ‡1, §3.





DAILY AVERAGE PRODUCTION FOR WEEK

	Sept. 17 crude oil	B. of M. Sept. demand	Sept. 10 crude oil
Alabama	1,450	1,350	1,150
Arkansas	70,600	88,000	72,750
California	893,600	920,000	894,700
Colorado	63,800	70,000	66,000
Eastern	57,200	60,800	58,950
Florida	1,125	1,400	1,150
Illinois	177,700	180,000	181,700
Indiana	27,400	28,000	29,300
Kansas	250,000	302,000	248,700
Kentucky	23,100	22,000	23,600
Louisiana	485,950	528,000	485,550
North Louisiana	113,950		113,550
South Louisiana	372,000		372,000
Michigan	42,200	46,000	40,700
Mississippi	95,550	110,000	98,600
Montana	27,300	25,000	27,000
Nebraska	600	700	600
New Mexico	124,200	134,000	124,200
Oklahoma	387,350	410,000	386,300
Texas	1,979,100	2,130,000	1,979,100
Dist. 1 (Southwest)	27,200		27,200
Dist. 2 (Southwest)	122,700		122,700
Dist. 4 (Southwest)	189,300		189,300
Dist. 3 (Gulf Coast)	373,000		373,000
Dist. 5 (Eastern)	34,500		34,500
Dist. 6 (Eastern)	83,250		83,250
East Texas field	244,400		244,400
Dist. 7-C (West)	50,300		50,300
Dist. 8 (West)	560,300		560,300
Dist. 7-B (W. Central)	61,325		61,325
Dist. 9 (N. Central)	140,300		140,300
Dist. 10 (Panhandle)	92,525		92,525
Utah	2,100	900	1,900
Wyoming	126,500	122,000	125,200
Total United States	*4,836,825	5,180,000	4,847,150
Change from prev. wk., down	10,325		
Canada	68,785		63,590

Total production January 1-September 17 †1,317,739,630 bbl.
Same period last year (crude plus cond.) 1,430,503,950 bbl.

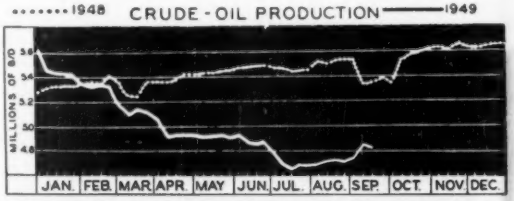
*Not incl. 81,375 bbl. condensate. †Incl. 21,550,155 bbl. condensate.

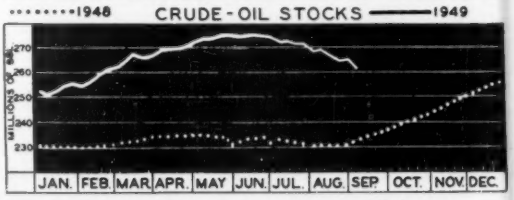
CRUDE OIL BY STATES OF ORIGIN*

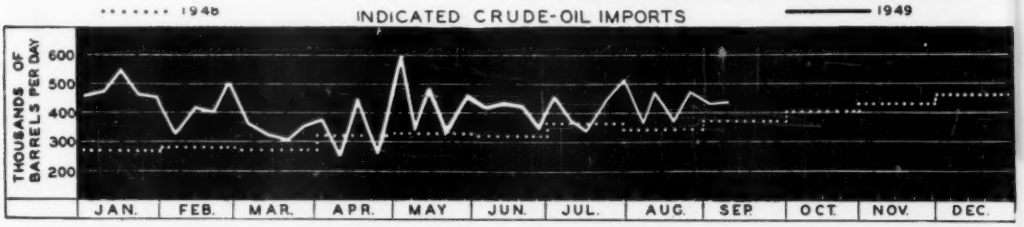
(Thousands of barrels)

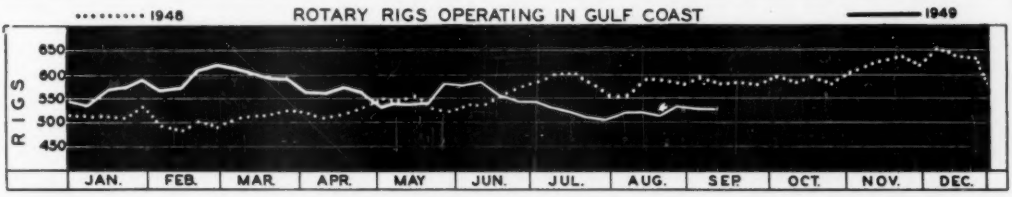
	Sept. 10, 1949	Sept. 3, 1949	Sept. 11, 1948
Pennsylvania Grade	3,303	3,393	2,743
Other Appalachian	2,354	2,124	1,310
Ill., Ind., Mich.	13,186	13,292	10,826
Arkansas	2,720	2,769	2,906
Louisiana	14,532	15,269	12,134
North	3,573	3,812	2,848
Gulf	10,959	11,457	9,286
Mississippi	2,629	2,752	2,841
New Mexico	7,535	7,590	6,263
Oklahoma and Kansas	38,892	39,046	35,020
Texas	118,235	121,223	110,652
East Texas	16,473	16,966	16,897
West Texas	47,363	48,130	42,351
Texas Gulf	27,804	28,968	27,641
Other Texas	26,595	27,159	23,763
Rocky Mountain	13,915	14,019	9,444
California	36,070	35,833	30,687
Foreign	7,765	7,303	4,607
Total United States	261,136	264,613	229,433

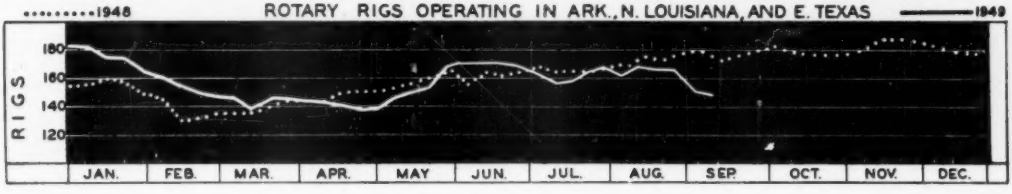
*Bureau of Mines











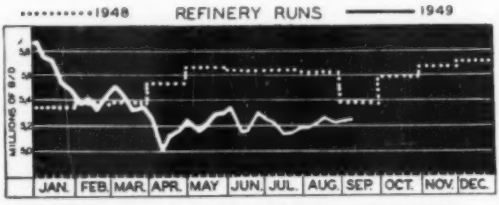
Refining Statistics

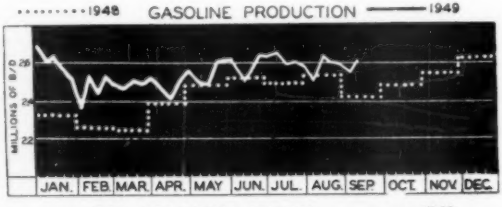
A.P.I. REFINERY REPORT, SEPTEMBER 10

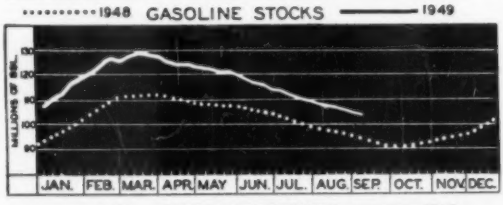
(Thousands of barrels)

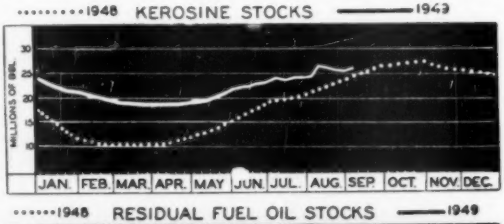
District—	Daily avg. crude runs	Daily average production				Stocks at refineries, bulk terminals, in transit and in pipe lines				Bureau of Mines, September 1948				
		Gasoline*	Kerosine	Distillate	Residual	Gasoline†	Kerosine	Distillate	Residual	Daily avg. crude runs	Daily average production			
											Gasoline*	Kerosine	Distillate	Residual
East Coast	729	327.3	26.9	176.3	158.7	23,976	11,039	23,646	10,153	878	306.9	36.8	180.8	231.7
Appalachian:														
District 1	96	45.4	5.0	9.6	7.7	2,427	417	700	430	99	42.7	5.4	12.8	13.1
District 2	62	33.0	2.3	4.4	12.9	1,080	141	249	113	27	13.0	1.4	4.6	9.2
Ind., Ill., Ky.	900	506.2	57.8	114.8	147.1	22,498	5,494	12,898	4,146	959	488.7	55.6	132.4	152.5
Okla., Kans., Mo.	414	236.9	19.6	75.4	58.9	9,121	1,737	6,381	2,025	474	248.5	22.6	86.9	76.3
Inland Texas	229	153.0	11.9	17.6	46.9	3,632	709	1,000	1,443	251	157.9	12.5	24.1	62.9
Texas Gulf Coast	1,267	611.7	85.8	253.0	234.8	14,494	3,328	12,181	7,552	1,427	625.9	102.5	308.9	250.6
La. Gulf Coast	447	236.0	53.3	88.8	55.1	5,600	2,148	4,206	2,160	438	191.7	53.3	82.7	72.5
N. La. and Ark.	77	34.1	6.1	13.3	16.6	2,731	446	898	310	86	33.4	8.0	13.0	18.4
Rocky Mountain:														
New Mexico	8	5.3		1.4	2.4	75	25	100	28	13	6.8	0.5	1.8	3.9
Other Rocky Mtn.	190	81.1	4.9	35.9	29.6	2,316	397	2,039	629	160	70.4	4.3	25.8	31.7
California	829	350.0	11.0	131.6	344.7	16,125	727	13,933	40,272	581	230.2	6.7	103.0	239.8
Sept. 10, 1949	5,248	2,610.0	284.6	922.1	1,115.4	104,375	26,608	78,231	69,261	5,393	2,416.1	309.6	976.8	1,162.6
Sept. 3, 1949	5,233	2,555.9	222.9	960.6	1,032.3	104,834	25,560	76,430	67,997					
Sept. 11, 1948	5,332	2,353.1	307.1	1,016.7	1,205.4	93,534	24,243	66,857	56,657					

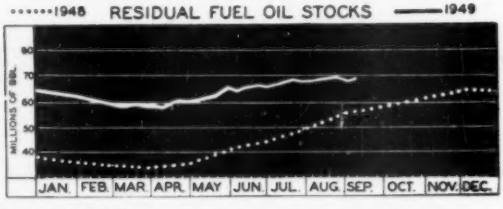
*At refineries including natural blended. †Finished and unfinished.

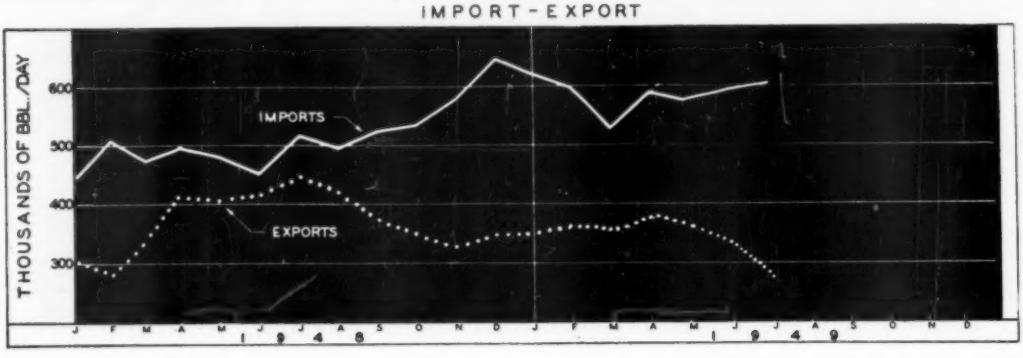












CRUDE PRICES
GRAVITY SCHEDULE

Gravity—	Signal Hill, Calif.	Oklahoma, Kansas	Gulf Coast Tex.*	West Tex.†
18-18.9	$1.53			
19-19.9	1.63			
20-20.9	1.73	$2.25		$2.12
21-21.9	1.82	2.27		2.14
22-22.9	1.92	2.29		2.16
23-23.9	2.02	2.31		2.18
24-24.9	2.12	2.33	$2.56	2.20
25-25.9	2.22	2.35	2.58	2.22
26-26.9	2.31	2.37	2.60	2.24
27-27.9	2.37	2.39	2.62	2.26
28-28.9	2.42	2.41	2.64	2.28
29-29.9	2.48	2.43	2.66	2.30
30-30.9	2.54	2.45	2.68	2.32
31-31.9	2.59	2.47	2.70	2.34
32-32.9	2.64	2.49	2.72	2.36
33-33.9		2.51	2.74	2.38
34-34.9		2.53	2.76	2.40
35-35.9		2.55	2.78	2.42
36-36.9		2.57	2.80	2.44
37-37.9		2.59	2.82	2.46
38-38.9		2.61	2.84	2.48
39-39.9		2.63	2.86	2.50
40 and above		2.65	2.88	2.52

*For crude from Daboval, El Campo, and Sand Point.

†Includes Lea County, New Mexico. Last general price change represented a 50-cent increase becoming effective December 6 1947. Above changes do not include recent reductions of a few buyers applying principally to low-gravity grades.

FLAT CRUDE PRICES

Representative posted schedules per barrel

East Texas†	$2.65
Kettleman Hills, California*	2.77
Beauregard Parish	2.60
Illinois Basin	2.77
Pecos County, Texas (Yates)	2.35
Bradford, Pennsylvania	3.40
Eastern Ill. and Western Ind.†	2.77
Tomball, Texas Gulf Coast	2.83

*37°-37.9°. †35° and above

EVIDENCE of the firmness of the distillate market was present again last week as major suppliers and distributors raised the price of No. 2 fuel at East Coast points following the increase by Socony-Vacuum Oil Co., Inc., a week earlier. New postings by Esso Standard Oil Co. differed somewhat from those by Socony, and it probably will take several days for markets on the East Coast to stabilize at the new level.

The new price in New York Harbor is still more than 15 per cent below the harbor price at this time last year. The present increases in distillate prices are not just seasonal changes but indicate a return to more normal prices after a subnormal market that has existed since early last spring. For example, New York retail prices for anthracite coal increased 5.5 per cent from July 1948 to July 1949. No. 2 fuel prices were reduced 17.9 per cent in the same period. In the absence of a large oversupply of home-heating oil, No. 2 prices can be expected to increase until a more normal relationship exists between the prices of No. 2 and coal.

Esso Standard Oil Co. announced an increase in the price of residual fuel for East Coast points effective September 16. The new increase, amounting to 20 cents per barrel, brings the New York Harbor price to $1.90. This is still about 35 per cent lower than the price last fall. Residual fuel stocks east of California at the end of August were about 5,600,000 bbl. less than at the same time last year. Low residual prices have resulted in reduced refinery yields and a failure to meet demands out of current production.

REPRESENTATIVE QUOTATIONS

Representative spot-market quotations of leading suppliers as of September 19, 1949. Figures are f.o.b. plant for tank-car shipment in cents per gallon, except for residual fuel oil which shows the price per barrel and wax, in cents per pound.

GASOLINE, KEROSINE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor (barge)	Tex. Gulf Coast
Regular gasoline, 74-76 octane	9⅝-10	11.5	9½-10
Premium gasoline, 78-80 octane	10⅜-11	12.5	10½-11
42-44 w.w. kerosine	7¾-8¼	8.4-8.9	7¾-8¼
No. 2 straw fuel oil	6½-6¾	8.0-8.5	6¾-7
No. 6 residual	$0.85-0.90	$1.70-1.90	$1.40-1.50

NATURAL GASOLINE

	Group 3	North Texas	N. La.
Grade 26-70	5½	5	5¼
Grade 18-55	6.6	6	6.3

LUBRICATING OILS
SOUTH TEXAS

200 vis., No. 2-3 neutral	10.5
750 vis., No. 3-4 neutral	13
2,000 No. 5-6 neutral	14-15

LUBRICATING OILS
Mid-Continent

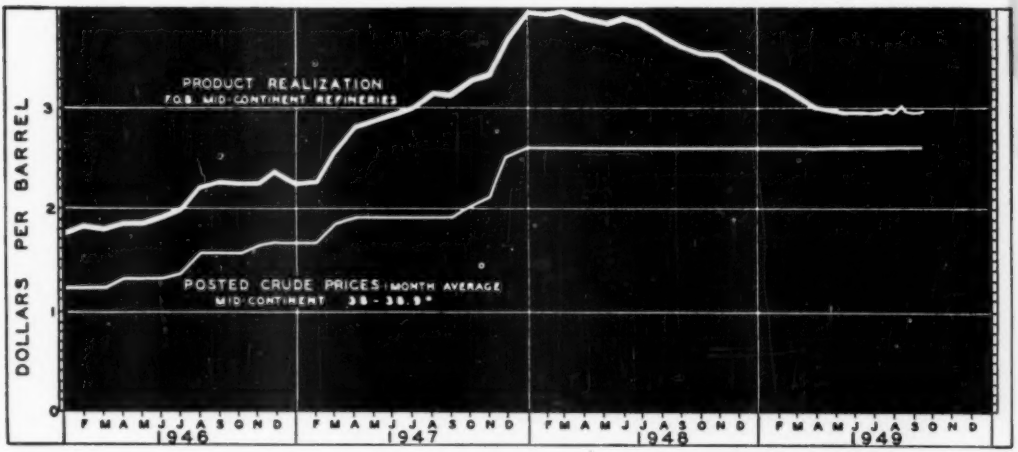
150-160 vis., D bright stock, 0-10 pp.	19
200 vis., No. 3 neutral, 0-10 pp.	12-14

Western Pennsylvania

145-155 vis., 10 p.t. bright stock	19.5
180 vis., 0 p.t. neutral	20.5

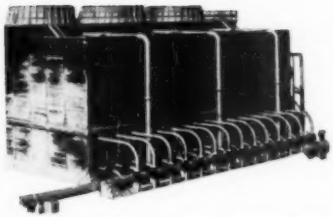
WAX
Mid-Continent

132-134 A.M.P.	4.25

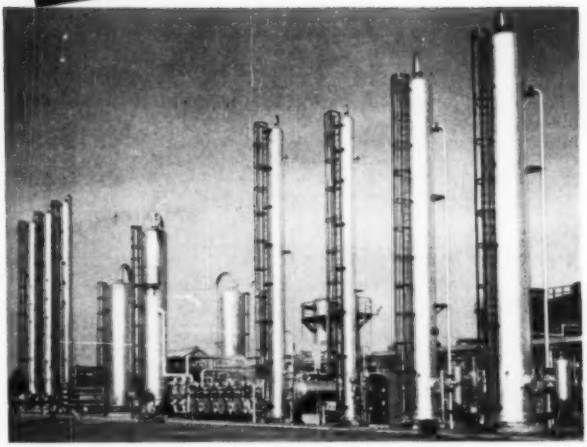


In this trend chart refinery realization is based on average Mid-Continent grade crude oil (not 38° gravity only) and average prices for refinery products as published in The Oil and Gas Journal basis Oklahoma (Group 3). Refinery yields confined to gasoline, kerosine, distillate, and fuel oil

CONTROL
Scale and Corrosion



in Cooling Towers, Compressors, Engine Jackets



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EQUIPMENT MEN . . . in the News

Girardeau Made District Sales Engineer by Ingalls

Ingalls Iron Works Co. has announced the promotion of Julian M. Girardeau to the position of district sales engineer in charge of its New Orleans office. Formerly located at the firm's main office in Birmingham in the capacity of sales engineer, Girardeau already has taken over his new duties.

He will also represent subsidiaries, Ingalls Shipbuilding Corp., and Steel Construction Co., as well as Birmingham Tank Co., division of Ingalls Iron Works Co.

Roberts Acquires Automatic Shut-Off Valve Rights

H. ROBERTS, JR.

Harry Roberts, Jr., owner of Roberts Pipe & Supply Co., Houston, announced that his company has acquired manufacturing and sales rights for the Automatic Shut-Off Valve, from its inventor, R. E. Meynig. This valve is being used by the oil industry as a safety factor on flow lines to protect against commodity loss or damage due to line breakage.

Roberts started his pipe and supply business following discharge from the Navy. For 7 years he was with Gulf Oil Corp. in Venezuela. Upon his return to the United States, he spent several years as a driller and production man, before joining A-1 Bit & Tool Co. a s district representative in Illinois, Indiana, and Kentucky.

Dow Plans Big Ammonia Plant in Freeport, Tex.

Plans for the construction of a 5-million-dollar ammonia plant at Freeport, Tex., have been announced by Leland I. Doan, president of Dow Chemical Co. The plant will have a capacity of approximately 100 tons per day.

Field construction is expected to start in January 1950, Doan said, and it is anticipated the plant will be in operation late next year. The plant will utilize hydrogen available from the company's huge chlorine plant there and combine it with nitrogen from the air to form anhydrous ammonia. It will employ 1,000-hp. gas engines for compression of the air and hydrogen.

Allen and Persson Awarded Glitsch Promotions

R. L. ALLEN

ALLAN PERSSON

Fritz W. Glitsch & Sons, Inc., has announced the promotion of Robert L. Allen to district manager at Cleveland. He was formerly manager of the company's Chicago office. Allen is a trained Glitsch technician. He attended Pennsylvania State College.

The Cleveland office serves Ohio, Pennsylvania, upper New York State, and eastern Michigan. Allen's promotion provides the newly established Cleveland office with a factory-trained man in this important, growing refining area.

Allan Persson, University of Kansas graduate, has been appointed manager of the Chicago office. Persson was trained in the Dallas plant of Glitsch particularly in tray and cap design. The Chicago office covers Indiana, Illinois, Kentucky, Missouri, Wisconsin, and part of Michigan.

Wilson Goes to Dallas to Represent Elliott Co.

Elliott Co., manufacturers of power-plant and industrial process equipment with headquarters in Jeannette, Pa., in order to have more adequate representation in the Dallas, Fort Worth, and East-West Texas areas, has located J. A. Wilson in Dallas. Wilson, formerly in the Tulsa office, will operate as a resident field engineer of the Tulsa district headquarters.

Walling Joins Nordstrom As Sales Engineer

B. C. WALLING

B. C. Walling has joined the Nordstrom Valve Division of Rockwell Manufacturing Co. as sales engineer. He will work out of the company's Houston office, under the direction of C. K. Madison, district manager.

Walling graduated from Southern Methodist University as a mechanical engineer. For the past 3 years he has been employed by Humble Oil & Refining Co. as a petroleum engineer.

Walling will be located in Corpus Christi, and will handle the work in the oil fields formerly handled by R. J. Munn, who was transferred to another territory.

Roebling Opens Denver Office and Warehouse

John A. Roebling's Sons Co., Trenton, N. J., manufacturers of wire products, has announced that its new Denver office and warehouse will be ready for occupancy on September 30. Homer H. Davis, who has represented Roebling in the Denver area for 23 years, will serve as manager, with Roy H. Hainsworth acting as his assistant. Fred L. MacLean will be in charge of oil-field sales.

Brudvig Joins Plastic Coatings as Engineer

L. A. Brudvig, formerly connected with Phillips Petroleum Co., has recently joined the staff of Plastic Coating Corp., Houston, as chief engineer. Brudvig has a B.S. degree in civil engineering from North Dakota State College, where he graduated in 1941. Shortly after this, he joined Phillips. While there he had considerable experience in various pipe-line work and the testing and inspection of oil-field materials.

In his present position Brudvig will devote much of his time to inspection and supervision of the appli-

cation of protective coatings to oilfield equipment including marine phases.

Tube Turns Moves Branch Office in Los Angeles

The Los Angeles branch office of Tube Turns, Inc., manufacturers of welding fittings and flanges, has been moved to General Petroleum Building. Manager of the Los Angeles branch is Norton P. Bosemer. He joined the sales staff of Tube Turns in 1937, was assigned to the San Francisco office in 1944 and transferred to Los Angeles in 1947. The main offices and plants of Tube Turns, Inc., are in Louisville.

Spafford Assigned to Eastern Area for Hooker

Hooker Electrochemical Co. has announced the appointment of Allen L. Spafford as field salesman in the territory comprising upper New York State and western Pennsylvania.

Spafford has been associated with Hooker for 2 years as a process study engineer. His headquarters will be at the Niagara Falls office of the Hooker company.

Calnon Becomes Sales Manager for Cummins

J. T. CALNON

J. T. Calnon's appointment as sales manager of Cummins Sales & Service, Inc., has been announced by J. E. Everroad, president and general manager. He will make his headquarters at the general offices in Fort Worth. Calnon came to Cummins in 1945 after his release from the Navy.

He worked as district service manager at the company's Houston and Wichita Falls service points until August 1947, when he was sent to Odessa as West Texas division service manager. There he planned and opened the company's huge new modern factory-type repair shop recently completed.

Lucey Export to Distribute Bucyrus-Erie Spudders

The recent appointment of Lucey Export (Canada), Ltd., as distributors for the line of Bucyrus-Erie oil-well spudders has been announced by Bucyrus-Erie Co. The firm will sell and service these spudders throughout the provinces of Alberta and Saskatchewan and in that portion of the Northwest Territory immediately north of Alberta.

Officers at Lucey Export's Calgary headquarters are E. M. Wilkinson, managing director; J. J. Saucier, K. C., director; H. W. Miles, sales manager; and George Robinson, salesman. Salesmen at the Edmonton store are Stu McKay, John McClean, and John W. Eaton.

Jarecki, Brake Equipment Move Fabricating to Tulsa

T. M. EVANS

T. M. Evans, president of H. K. Porter Co., Inc., has announced the movement of the manufacturing department of the Brake Equipment & Supply Co., and Jarecki Manufacturing Co., to the Hinderliter plant in Tulsa. The valve and fitting manufacturing plant of Jarecki is being moved from Erie, Pa. This company is a very recent acquisition by H. K. Porter Co. interests and is one of the oldest of all supply companies servicing the petroleum industry on a national basis. Howard Pape, Jarecki vice president and director, will continue in Jarecki sales headquarters at Houston.

HOWARD PAPE

R. A. CAMPBELL

C. J. Smith, now manager of Brake Equipment Co. in Chicago, will move to Tulsa. This company, another of the H. K. Porter interests, manufactures railroad air brakes and parts, steam and diesel locomotive parts, and a well-known line of industrial lubricated plug valves.

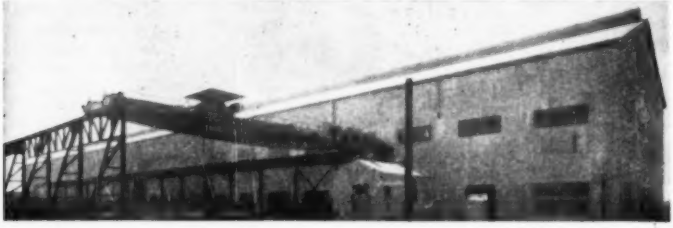
While the manufacturing facilities of Hinderliter, Jarecki, and Brake Equipment are being combined, R. A. Campbell, vice president and general manager of Hinderliter, stated all will retain their individualities and trade names. He further stated that the Hinderliter plant in Tulsa, with over 89,000 sq. ft. of manufacturing, laboratory, service, and office space, is well equipped to handle the large production of the diversified industrial products sold by the three companies, and that this centralization of facilities would place the manufacturing facilities closer to its major markets.

William F. Klemp Co. Starts Operations in Houston

E. C. WHITNEY

William F. Klemp Co., fabricator of structural steel footwalks, has recently opened a new plant on Wallisville road in Houston to serve Houston and the Gulf Coast area. The new plant, which during the war was part of Howard Hughes' strut plant, will produce electroforged open steel grating and treads, diamond-riveted steel and aluminum grating and treads, diamond-riveted open steel bridge decking, Hexteel heavy-duty surface armor for use as ganister lining in cat crackers, and Floorsteel flexible floor armor.

Sales representative for the new plant, according to Emerson C. Whitney, president, will be H. L. Thompson, who has been the Houston representative for the Chicago firm for the past 20 years. Additional sales representatives will be named in other Texas cities. The company now has 103 sales offices in the United States and 33 in foreign countries.



Plant to be operated by William F. Klemp Co. was acquired from Property of Defense Plant Corp., a subsidiary of Reconstruction Finance Corp., is 553 ft. long and 104 ft. wide with clearance height floor to bottom chord of 46 ft.

Peabody Engineering Promotes Peterson

E. G. PETERSON

Ernest H. Peabody, president of Peabody Engineering Corp., manufacturers of all types of fuel-combustion equipment, gas scrubbers, gas coolers, and direct-fired air heaters has announced the appointment of Eric G. Peterson as general manager.

Peterson will continue as general sales manager of all products in all divisions. A graduate of Stevens Institute of Technology, Peterson became associated with Peabody in 1928 in the capacity of engineer, later transferring to the sales department.

Brown Instruments Makes Changes in Sales Staff

Brown Instrument Division of Minneapolis-Honeywell Regulator Co. has recently announced several changes in its top sales organization.

John A. Robinson has been named regional sales manager for the Midwest, Northwest, Rocky Mountain, and Pacific Coast areas.

Charles E. Sharp has been made Chicago branch industrial manager. Charles D. McIntire has been named industrial sales manager of the Cincinnati branch office; John E. MacConville has been named industrial sales manager of the Atlanta branch office; and William C. Waltman has been put in charge of industrial sales of the South Bend office, succeeding George Gilliam who will supervise all pyrometer-supplies sales for the company.

Robinson joined Brown 20 years ago at the Philadelphia main plant. He will make his headquarters in Chicago. Sharp, who succeeds J. A. Robinson as branch industrial manager in Chicago, has also been with the company 20 years.

McIntire succeeds George Brown, who has been assigned to promotion of products of Honeywell's Belfield Valve division. MacConville will also supervise industrial sales activities out of the company's Birmingham, Jacksonville, and Knoxville offices.

Tagliabue Appoints New Sales Representative

C. J. Tagliabue Corp., wholly owned subsidiary of Weston Electrical Instrument Corp. has announced the appointment of the following district sales representatives: E. A. Thornwell, Inc., Atlanta; Ranson, Wallace & Co., Charlotte; Ambos-Jones Co., Cleveland; Butler & Land, Dallas; Lynn Elliott Co., Houston; Curtis H. Stout, Little Rock; Geeseka & Pinkney, Minneapolis; Joralemon, Craig & Co., Philadelphia; J. E. Redmond Supply Co., Phoenix; and Riddle & Rubbell, Tulsa.

The complete line of Tagliabue instruments includes automatic controllers, hydrometers, hygrometers, moisture meters, oil-testing instruments, pyrometers, recorders, recorder controllers, resistance thermometers, thermometers, vacuum gages, and valves.

Grizzell Returns From Middle East Duty

E. I. Grizzell, party chief for Independent Exploration Co., Houston, recently returned from a several-year tour of duty in the Middle East, including Iraq, Qatar, Syria, and the Trucial Coast. Grizzell believes his party was among the first to make seismograph surveys in Syria. He has now been placed in charge of an I.X. party in Montana.

Baker Made Plant Manager For Glass Fibers, Inc.

Richard Baker has been appointed plant manager of Glass Fibers, Inc., Waterville, Ohio, it has been announced by R. H. Barnard, president. He has been with the company since its inception and until recently was in charge of production control.

Day to Sell Pittsburgh Coatings in Southwest

S. D. DAY

Appointment of S. D. Day Co., Houston, as Southwest representative for Pittsburgh Protective Coatings has been announced by Robert M. Moore, sales manager of Pittsburgh Coke & Chemical Co. S. D. Day, head of the sales firm, is well qualified to represent Pittsburgh Coke & Chemical in this connection. A practical student of pipe-line corrosion for over 20 years, Day helped pioneer the sale of coal-tar pipe-line enamels and related materials in Texas and on the West Coast.

Day was formerly with Barrett Co., and, more recently, was vice president in charge of Southern sales for Pipe Line Service Corp. He established his own company in 1949.

Brown Heads Bethlehem Office at San Antonio

GUY BROWN, JR.

Bethlehem Steel Co. has announced the opening of a sales office at San Antonio, with Guy Brown, Jr., as engineering representative. Brown graduated from Missouri School of Mines in 1940, with the degree of bachelor of science in metallurgical engineering. After joining Bethlehem, he spent 1 year at Bethlehem, Pa., and was then transferred to Bethlehem's home office in Tulsa.

Upon his return from military service in October 1946 he was assigned to the Oklahoma district office at Oklahoma City as engineering representative. W. J. Brady, manager of the Southwest Texas district at Corpus Christi, has supervision over the San Antonio branch.

Homco Announces New Sales Divisions

C. P. SMITH

Houston Oil Field Material Co., Inc., has announced new divisional sales territories by the promotion of C. P. Smith from district manager, to Southwest Texas division manager, with stores at Bay City, Victoria, Kenedy, Corpus Christi, Premont, Alice, Freer, Sullivan City, and office at San Antonio.

Serving as district managers under Smith will be R. M. Freeman, serving Bay City, Victoria, Kenedy, and headquartering in Victoria. R. L. Lynd will service Freer, Premont, and Sullivan City, headquartering in Alice. Smith has been with Homco for 17 years and makes his headquarters in Corpus Christi.

Continental Supply Names Several Store Managers

Announcement has been made by Continental Supply Co. regarding several appointments in store management. Dean P. Davis has been named manager of the Houston store and warehouse.

D. F. Bell, formerly manager of the El Campo store, has been transferred to Corpus Christi as city salesman. He is succeeded by J. C. Short in El Campo. C. A. Robison has been appointed manager of the Casper, Wyo., store and B. C. Prowell fills the same position in the store at Artesia, Colo.

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FOR SALE: 68 Class 2 Tank Cars 8000 Gal. Good Running Order. Delivery East and Middle West. $675 Each. R. C. Stanhope. 60 E. 42nd St., New York, N. Y.

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ONE 40 H.P. O.C.S. Pumping Unit, 25,000 pound polish rod load. Eli Wilkonson, Box 1581, Phone 5-3545, Tulsa, Oklahoma.

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FOR SALE: Radial drill press used six months. One Jackson engineering reboiler, size 16-35-75, tube pressure 175 lbs., temperature 380° F. Model #1, heater #265. Excellent condition. Box 610, Mt. Pleasant, Texas.

CORE Drilling & Shot Hole Rigs; Longyear, Sullivan, Franks, Chicago Pneumatic. Good used equipment, ready for service. PK rods, N rods, B rods, bits, Spudders and cable tools. Everything for well drilling. We save you money. Pressey & Son, Pueblo, Colo.

FOR SALE: One FXO-172 7⅛ x 10 Gardner Denver pump with skids, 48" pulley and suction hose, in good condition, $2750.00. One 12000 Cat Diesel Motor, run 935 hours, overhauled, $2300.00. One Gumbo Buster Swivel, good condition, $300.00. One Oil Well 60 traveling block with hook, good condition, $400.00. One Wilson Mogul draw works, overhauled, $1750.00. This equipment may be inspected at Bury Manufacturing Corp., Highway 64 East, Princeton, Indiana.

NATIONAL "50" Compound Double Drum Rig 126' Cantilever Ideco Mast, 10' substructure, 6,000' 4½" drill pipe, this rig complete and in excellent condition. P.O. Box 205 Sta. B, Bakersfield, California.

PACKAGED H_2S REMOVAL UNITS

We offer prompt shipment on skid-mounted hydrogen sulfide removal units for treating sour gas for pipe line or fuel gas purposes.

GRAFF ENGINEERING & EQ'PT. CO
3415 Westminster, Dallas 5, Texas

FOR SALE

12—230 H.P. Type 10 Bessemer New 17" Power Cylinders complete ready to run with 18" to 18" Compressors. 1—230 H.P. Clark Horizontal with Compressors. Located Salem, Illinois.

ENGLE PETROLEUM, Incorporated
Box 655, Evansville, Indiana

WE CARRY THE LARGEST STOCK OF

New Parts for Civilian & Army Trucks

Winches, Steel Snatch Blocks, Pulleys, Heavy Duty Tools, and Equipment

Phone! Wire! or Write!

RING BROS.
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Phone: ELizabeth 5-7800

DIESEL POWERED PUMPING EQUIPMENT

A number of 2 cycle and 4 cycle Diesel Engines 200 to 750 HP. All under 300 R.P.M. Geared to plunger pumps handling 420 to 1470 GPM at 750 lb. On foundations in Ill., Mo., Kans., and Okla. Will sell units complete or Engines and Pumps separately.

Priced to allow purchase of Engines or Pumps for Spare Parts.

Inquire—Purchasing Agent

STANOLIND PIPE LINE CO.
Box 1979, Tulsa, Oklahoma

VALVES · **PIPE** · FITTINGS

PIPE SIZES
⅛" to 24" standard weight, extra heavy-hydraulic (limited stocks up to 60")

FABRICATING
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STRUCTURAL PIPE FOR RAILINGS, FENCES, AWNINGS, COLUMNS

Foster maintains complete equipment for:
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EQUIPMENT FOR SALE

FOR SALE, at Oklahoma City: 17,500′ of $2^7/_8$″ OD 6.4 upset seamless steel tubing line pipe and 12,500′ of 3″, 7.7 TMC and PE line pipe, all used. Cheap. Cities Service Oil, Patridge, Bartlesville, Okla.

FOR SALE: Foxboro, Westcott and Emco Orifice Meters with Piping, Mercury and Leveling Saddles. Also Davis and Chaplin-Fulton Regulators. George R. Milner, Okmulgee, Oklahoma.

FOR SALE: New Beaird Packaged Compressor Plant with Ingersoll-Rand Type 6XVG 225 HP two stage gas compressor equipped with hand operated fixed volume pockets. Intake pressure range 100-200 PSI. Discharge pressure 1000 PSI. Capacity range 1,450 to 2,050 MCF. Ready to operate. Location Bishop, Texas, Box D-161, The Oil and Gas Journal, Tulsa, Oklahoma.

Several Army Surplus 4½″ x 6″ Gaso Duplex 1860 Pumps—two piece skid mounted with Chrysler 8 cylinder engines. Will sell pumps only or complete units about half price.

H. H. COFFIELD
ATTN: W. H. Orr
Phones: 132—Rockdale, Texas
A-86064—Houston, Texas

STEEL BUILDING

Used 51′ x 117′ with 16′ walls pre-fabricated heavy duty steel building; to be moved. Has 17—5′x8′ steel sash windows and 7 sliding doors. Covered with heavy 22 gauge corrugated iron and designed to carry a traveling crane. Ideal for plant, factory, machine shop or warehouse. Excellent condition. Reasonable price. Will mail picture upon request. Call, write or wire:

O. K. PIPE AND SUPPLY CO.
P. O. Box 4441; Phone 6-5447
Oklahoma City, Okla.

FOR SALE

at Oklahoma City, Attention Lee Croom:

1—8″ Landis Type 8 Ser. # 144-4 Pipe Machine with 2 Landis Heads	$2,750.00
1—3′ Canedy Otto Radial Drill, bought '44	2,000.00
1—Barnes 20″ Upright Drill	500.00
1—Aristo Pedestal Type 3 HP Power Grinder	165.00
5—300 Amp. Elec. Lincoln Welding Mch. Skid Model, Ea.	200.00
1—400 Ditto	200.00
1—28 Wells Steel Horiz. Band Saw	200.00
3—2″ Toledo Higir Speed Pipe Machine, ½″ to 2″ w/ Quick Opening Head, each	850.00
1—Toledo AC Power Drive with Univ. Drive Shaft	200.00

CITIES SERVICE OIL COMPANY
Patridge, Bartlesville, Okla.

COMBINED VAPOR SEPARATOR & FRACTIONATOR FOR THERMAL REFORMING

One (1) New 5′-6″ ID x 61′-0″ over-all height Bubble Tower made of 1¼″ Plate and lined throughout with 5/64″ and 7/64″ thick, 11-13% Chrome stainless steel, type 405. Stainless steel support plates in place for 15 Trays, (Trays not included). Constructed in accordance with the API-ASME Code, stress relieved and radiographed. Designed for 400 PSI @ 750° F. Fabricated by A. O Smith Corporation. Platform and ladder clips installed.

WOOD RIVER OIL & REFINING CO., INC.
335 West Lewis Street, Wichita, Kansas
Telephone 7-3325

EQUIPMENT FOR SALE

404 CORE BARREL—Drills faster, takes larger core, runs in 6¼ inch casing. Makes $2^7/_8$ inch core. Prices quoted on request. Mf'g by East Side Machine Works, 17 S. Ashby, Chanute, Kansas.

FOR SALE: Two Fairbanks-Morse Diesel Engines, 150 H.P. Twin Cylinder, Horizontal Type. Completely overhauled. $1500.00 each Melton Supply Co., Seminole, Okla.

FOR SALE: Two like new 74,000 bbl. cap. tanks. Low price, at Morgantown, W. Va. 2 new 10,000 bbl. bolted at N.Y. Darien Corp., 60 E. 42nd St., N. Y., N. Y.

FOR SALE: Cardwell Rotary Rig, complete with Mast. Suitable for 3,500 ft. drilling. Bargain. Terms. Melton Supply Co., Seminole, Okla.

ROLAGRIP COUPLINGS—For Sale, 100 tons, 1½″ to 8″ line, Blk. & Galv. Complete with bolts and neoprene gaskets. Never in use. Send for list and price. Julius M. Fogelman, 1649 Perkiomen Ave., Reading, Penna.

FOR SALE: National Rotary Rig mounted on 1942 Chevrolet Truck, complete with 650 ft. drill stem, two core barrels, six drag bits, also other parts. Price $2500.00. Wesley C. Young, Box 5294, Sonora, Texas.

2—170 HP Type 80 Twin Cooper, 2—80 HP Type 8 Bessemer, Direct Driven Compressors. 2—50 HP Type EC Bessemer Gas Engines. 2—18x12 Worthington Twin Vacuum Pumps. Also cylinders and spare parts for Cooper, Bessemer, Clark Compressors. Nolan Sales Corp., Tulsa, Okla.

FOR SALE: Failing "1500" portable rig for shot-hole, core, water-well, and shallow production drilling. Equipped with sand reel and bailer. Mounted on GMC truck. Rig and Truck in excellent condition. Rider & Montgomery, Box 523, Douglas, Wyoming.

FOR SALE:
6000 ft. of new 6¼ plain end pipe.
A. R. Daniel, Garnett, Kansas.

FOR SALE: Approximately 25 miles 4″ OD plain end pipe in line. Public Service Corp. of Texas, 902 Burk Burnett Bldg., Fort Worth, Texas.

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Manufacturers
INDUSTRIAL GEARS & SPROCKETS, MACHINE PARTS OR COMPLETE ASSEMBLIES.
WE Know How TO PUT Your Ideas INTO PRODUCTION
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LOCOMOTIVES FOR SALE OR LEASE

2—100 ton, diesel electric, tractive effort 59,700#, four traction motors, new 1940-42, excellent condition for ICC.
1—44 ton, GE 380 HP railway type diesel electric switcher, new 1945, Caterpillar D-17000 diesel units, four traction motors.
2—65 ton Porter saddle tank steam locomotives, new 1942, immediate delivery.

LOCOMOTIVE CRANES

1—Ohio Model F 30 ton diesel powered new 1946, double drums, Caterpillar diesel unit.
2—Ohio Model G 35 ton gas powered new 1943 but unused, Buda power units, double drums.

CARS

75—all steel 70 ton capacity hopper cars
25—all steel 50 ton drop bottom gondolas
19—all steel 20 cu. yd. air dump cars

Our stock includes many other locomotives, cars, cranes and heavy equipment items.
We invite your inquiries.
Write — Phone — Wire

PAN-AMERICAN ENGINEERING CO.
P. O. Box 2576 Telephone L.D. 339
Dallas, Texas

PATENT ATTORNEYS

PATENT Practice before U. S. Patent Office. Validity and Infringement Investigations and Opinions. Booklet and form "Evidence of Conception" forwarded upon request. Lancaster, Allwine & Rommell, Registered Patent Attorneys, Suite 418, 815-15th Street, N.W., Washington 5, D. C.

EQUIPMENT WANTED

WANTED—1,000 Victaulic Couplings for 4″ O.D. Invasion pipe with 4½″ O.D. Shoulder. Quote price, condition and location. Box D-184, The Oil and Gas Journal, Tulsa, Oklahoma.

PIPE, Valves and Propane tank wanted: 3″ and 4″ pipe car load lots, no objection to internal corrosion and pitting, also Propane tank, also unloading compressor, also high pressure valves and cocks up to 3″. Aylmer Trading Co., Aylmer, Ontario.

HELP WANTED

NEW foreign and domestic Oil Employment Directory. Over 500 listings in drilling, production, refining, natural gasoline, pipe lines, geological, exploration, supplies, manufacturers, services; and trucking, refinery and pipe line contractors, showing where to apply for jobs. Price $5.00. Oil Industry Mailing List, Box 2603, Tulsa, Okla. (Our 28th year).

MUD ENGINEER or chemist to act as sales representative for new product, Kingseal, which is an oil well mud sealing fiber. Kingseal regains and prevents lost circulation. Laboratory and actual field tests prove Kingseal superior to any other product on the market. Prefer man with lengthy experience in Texas drilling and oil production. Kingseal is copyrighted and patent is applied for. Write owner, Homer L. Twining, Sta. A., Box 4151, San Antonio, Texas.

CORROSION MEN: Must have broad, thorough technical education, not less than five years of successful experience in application of cathodic protection to underground metallic structures, also broad knowledge of application of insulating coatings used to protect against electrolytic and anaerobic corrosion. Box D-199, The Oil and Gas Journal, Tulsa, Oklahoma.

HOUSTON DISTRICT Sales Engineer: Engineer familiar with pumps, compressors, exchangers, etc., having sold this type of equipment in Texas for at least the last 3 years to refinery, gasoline plant, and pipe-line companies. Replies confidential. Box D-117, The Oil and Gas Journal, Tulsa, Oklahoma.

MECHANICAL ENGINEER. A Texas corporation needs an experienced oil tool design engineer. This man must have outstanding ability, a good employment record, and a capacity to create and develop new ideas. College background desirable. This is a good position with splendid opportunities for advancement. Please write to Box D-197, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED: Land Man, capable of judging merits of acreage submittals for drilling and negotiating agreements for same. Please detail past experience. Answers held confidential and no inquiries made without permission. Liberal compensation. Box D-192, The Oil and Gas Journal, Tulsa, Oklahoma.

BUSINESS MANAGER

To be located at main headquarters of independent production company. Geological and trading background to supervise West Texas district office; experienced in analyzing deals for proven and unproven crude properties, lease acquisitions, farm-ins, farm-outs and development of sound promotion program.

PETROLEUM GEOLOGIST

Thoroughly experienced in West Texas, able to recommend acquisition of leases and drilling thereof, proven and unproven crude properties, farm-ins, farm-outs, etc.

Our Client's Personnel Know of This Advertisement Submit resume and salary requirements.

EXECUTIVE SERVICE CORPORATION
(Agency)
19 West 44th Street, New York 18, N. Y.

HELP WANTED

GRADUATE Civil Engineer, not over 35 years of age, preferably with pipeline experience, for work in engineering department of medium sized pipeline company located at Tulsa. Box D-186, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED—Experienced Seismologists and Seismic Computers by large, well established geophysical company. Give full details of education and experience in letter. All replies will be held confidential. Reply Box D-188, The Oil and Gas Journal, Tulsa, Oklahoma.

PIPELINE INSPECTORS: Arc welders, lay, ditch, paint, lowering-in; only those with broad main line experience accepted; job located Mid-West; attractive wages if accepted; work begins immediately. Write full experience. 715 Midland Building, Kansas City 6, Missouri.

WANTED: Experienced Gravity Party Chiefs for crews in United States and Canada. Reply Box D-189, The Oil and Gas Journal, Tulsa, Oklahoma.

ENGINEER: Thorough university background followed by five or more years of outstanding achievement a definite requirement. Must have creative ability, a precision-technical mind. Men of less ability should not make inquiry. Salary commensurate with rigid requirements. A Missouri corporation. Correspondence confidential. Box D-200, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR large company operating throughout Mid-Continent and Rocky Mountain states. Contract man with land experience and knowledge of operations. Excellent opportunity. Please state education and experience. Inquiries confidential. Box D-167, The Oil and Gas Journal, Tulsa, Oklahoma.

SECONDARY RECOVERY ENGINEER Graduate Engineer. Three years field experience in waterflooding. Locate in Eastern Kansas. Salary open. Reply Box D-201, The Oil and Gas Journal, Tulsa, Oklahoma, giving age, education, experience, and salary desired.

SITUATIONS WANTED

PETROLEUM Engineer: 26 years old, wants a job with a future. Have always followed and taken greatest interest in drilling business. Have roughnecked and actually drilled for a total of three years. Box D-193, The Oil and Gas Journal, Tulsa, Oklahoma.

REFINERY Superintendent: 35, desires change. Fifteen years experience crude distillation, thermal cracking and treating. Would consider shift foreman or stillman job with aggressive company. References available. Box D-205, The Oil and Gas Journal, Tulsa, Oklahoma.

ACCOUNTANT-Office Manager: Experienced all phases petroleum accounting, production, refining, drilling, financing, taxes. Desires similar position with reputable independent. Age 33, married. Box D-202, The Oil and Gas Journal, Tulsa, Oklahoma.

CHEMICAL ENGINEER — Can supervise operation and maintenance of your natural gasoline-LPG plant for highest efficiency through modern technical methods—age 29, married. Box D-198, The Oil and Gas Journal, Tulsa, Oklahoma.

DRILLING Superintendent, cable tools, now employed, desires change. Experienced all phases drilling industry. Lately have specialized in Bucyrus-Erie equipment. Box D-208, The Oil and Gas Journal, Tulsa, Oklahoma.

ATTENTION: Well established oil well drilling contractor desires to manage and supervise: Individuals', groups', small or medium-sized oil companies' drilling, production and operating problems in Central and Western Texas, and New Mexico. Personal interview by appointment is desired. Makin Drilling Company, Box No 131, Ph. No. 131, Hobbs, New Mexico.

MICROPALEONTOLOGIST - GEOLOGIST, B.A., M.A., four years exploration and development experience in Ecuador, Peru, with major oil company, special interest paleo-stratigraphy; for foreign or domestic service. Excellent recommendations. Box D-196, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

SEISMOLOGIST
(Interpretation—Rework), with domestic and foreign experience. Desire position in U. S. Box D-195, The Oil and Gas Journal, Tulsa, Oklahoma.

LANDMAN-SCOUT, six years; accounting four years, all for independent operator, desires connection. Good background and training, married, steady and reliable, references. Write Box D-207, The Oil and Gas Journal, Tulsa, Oklahoma.

ENGINEER-ACCOUNTANT: Desires connection as administrative assistant to management of reputable petroleum company. Thirty years practical experience in management problems in all divisions of the industry. Capable analyst and researcher, operations, property evaluation and economics, administrative matters. Familiar with corporate laws, taxes, reports S.E.C. regulations. Soundly versatile and thorough. Good personality. Box D-203, The Oil and Gas Journal, Tulsa, Oklahoma.

FIELD Geologist: Reconnaissance and detailed mapping experience, domestic and foreign exploration. Fluent Spanish, foreign service preferred. Box D-204, The Oil and Gas Journal, Tulsa, Oklahoma.

LEASE AND DRILLING BLOCKS

MY ASSOCIATES and I will buy producing oil or gas properties. What have you? Brokers cooperate. Moss, 7733 Reading Road, Cincinnati 16, Ohio.

FOR SALE: Oil and Gas Leases and drilling propositions in shallow territory of Allen, Simpson, and Warren Counties, Kentucky. W. P. Harley, Bowling Green, Ky

WILL BUY gas or oil production, large or small. Prefer properties with some undeveloped acreage. Might consider drilling deals. Box D-172, The Oil and Gas Journal. Tulsa, Okla.

WILL exchange beautiful 8-room home on 1½ acres on Galveston Bay, La Porte, Texas, worth $30,000.00, for oil leases, royalties or oil lands of equal value. W. P. Thomson, 437 South Hill Street, Los Angeles, California.

1916 ACRE oil lease S.W. Wyoming, on Anticline, 5 Mi. of & in line with Major Oil Co. Well now drilling. One-half or all for $2.50 an acre. R. O. Barnsley, 950 Lincoln Ave., Palo Alto, Calif.

COCHISE Co. Ariz., Drilling Block; Sulphur Sprgs. Valley, 8000 acres for 4000 ft. test. Chas. Baldwin, Box 1107, Goodyear, Ariz.

NEW MEXICO OIL

We are pleased to recommend leases or royalty located on high contours near Permian well on structure which core drilling shows to be SE New Mexico's next great potential oil field. Maps & details mailed gratis to responsible parties.

Box D-206, The Oil and Gas Journal, Tulsa, Oklahoma

LEASES ROYALTIES

PRODUCING OR NONPRODUCING

Texas, New Mexico, Oklahoma, Louisiana and Illinois

Inquiries Invited

B. D. BUCKLEY

80 Broadway Drive, Clayton (5), St. Louis, Missouri

NORTH DAKOTA MINERALS

Bought direct for you on purchase order. I am thoroughly familiar with this play. Wire, call or write

JOHN ALLEN
808 Clarence Parker Hotel
Minot, North Dakota

(Member National Oil Scouts and Landmen Association. References exchanged.)

LEASE AND DRILLING BLOCKS

OIL LEASES, Ohio, Berea 700' proven 33 wells 364 A. or part, inexpensive, 23 wells 20 Brls. natural. E. N. Rehler, Allegany, N. Y.

ROYALTIES

DEEDED ROYALTIES
San Juan Basin & Permian Basin. Write Harry S. Wright, Wright Bldg., Farmington, New Mexico.

WE will buy producing or non-producing oil royalties. Standard Security Company, 595 Madison Avenue, New York 22, N. Y.

ABOUT 2500 acres royalties good to 1985 at $6.00. Edge Hartley & Moore counties, near Sunray. 2 gas wells 1½ miles to East. Contact A. H. Hesse, Agent, Dalhart, Texas.

CASH for your producing royalties, no delay, quick action. Jack Eagle, 311 Tradesmen Bldg., Okla. City, Okla. 7-7027 or 9-0421.

ROYALTIES IN HOT AREAS!
Recent strikes have focused attention on Montana's deeper oil zones and major companies are moving fast, drilling and leasing. We buy direct in the field, sell direct to our customers. Write LANDOWNERS ROYALTIES COMPANY, Box 1225, Great Falls, Montana.

CASH MARKET for PRODUCING ROYALTIES
ROBERT L. KINKAID
World Bldg. Tulsa, Oklahoma

WILL buy small producing oil royalties. Send description and oil run records. No brokers. Okmulgee Royalty Co., 1321 Natl. City Bldg., Dallas, Texas.

LEGAL BLANKS

BURKHART LEGAL BLANKS since 1908. Oil-Gas (all states), Business, Real Estate, Legal Forms, Leases, Revised With Government Regulations. Commercial Printing. Catalog and Samples on request. Burkhart Printing & Stationery Company, 119 South Cincinnati, Tulsa 3, Oklahoma.

FOR SALE

TRUCK LETTERING AND TRADEMARK DECALS made for your trucks and equipment. Easy to apply, uniform, distinctive, economical for small or large needs. Write for catalog. MATHEWS COMPANY, 827 S Harvey, Oak Park, Illinois.

WANTED

Distributor Wanted

By Leading Manufacturer of
CORROSION RESISTENT COATINGS

Need distributor sales representation in Texas-Louisiana. Warehouse facilities required with close working arrangement with applicator or own application unit. Much promotional work has been done in Southwest.

Write Box D-180

THE OIL AND GAS JOURNAL
Tulsa, Oklahoma

BUSINESS OPPORTUNITIES

FOR LEASE
On a Royalty Basis
By Owner

Contiguous group of 12 gold mining claims in Canada, either Crown granted or in process. Several veins located, a very heavy one has been opened to the 300-foot level. It carries workable values as demonstrated by production of more than $100,000 in prospecting operations. Negotiations invited with principals, only, financially able to exploit and develop to any extent recommended by their engineers. No brokers or promoters. Contact by letter addressed to **Box D-210, The Oil and Gas Journal, Tulsa, Okla.**

CALENDAR OF EVENTS

September

American Chemical Society, 116th national meeting, Atlantic City, N. J., September 18-23.

Western Petroleum Refiners Association, regional industrial-relations meeting, Washington-Youree Hotel Shreveport, September 23.

Mid-Continent Oil and Gas Association, twenty-seventh annual convention, Louisiana-Arkansas division, Roosevelt Hotel, New Orleans, September 22-23.

American Institute of Mining and Metallurgical Engineers, regional meeting, Neil House, Columbus, Ohio, September 25-28.

National Association of Corrosion Engineers, West Texas Chapter, annual Permian basin corrosion tour, Midland, Tex., September 27-30.

American Society of Mechanical Engineers, fall meeting, Hotel Lawrence, Erie, Pa., September 27-30.

Colorado School of Mines, seventy-fifth anniversary observance, Golden, Colo., September 29-October 1.

October

Independent Petroleum Association of America, Texas Hotel, Fort Worth, October 2-4.

American Society of Mechanical Engineers, petroleum division, 1949 Petroleum Mechanical Engineering Conference, Biltmore Hotel, Oklahoma City, October 2-5.

National Association of Corrosion Engineers, South-Central Regional Division, annual meeting, Adolphus Hotel, Dallas, October 3-4.

National Lubrication Grease Institute, Hotel Roosevelt, New Orleans, La., October 3-5.

California Meter Association, twenty-second annual measurement and control-instrument exposition, Long Beach Auditorium, Long Beach, Calif., October 4-6.

American Institute of Mining and Metallurgical Engineers, Petroleum Branch, fall meeting, Plaza Hotel, San Antonio, October 5-7.

California Natural Gasoline Association, Ambassador Hotel, Los Angeles, October 7.

American Society for Testing Materials, Pacific area, national meeting, Hotel Fairmont, San Francisco, week of October 10.

American Association of Petroleum Geologists, regional meeting, Buena Vista Hotel, Biloxi, Miss., October 12-14.

Symposium on Instrumentation for the Process Industries, fourth annual session, School of Engineering, Texas A. & M. College, College Station, Tex., October 12-14.

Texas Mid-Continent Oil and Gas Association, annual meeting, Rice Hotel, Houston, October 13-14.

Oil Progress Week, October 16-22.

American Gas Association, annual convention, Chicago, October 17-20.

American Institute of Mining and Metallurgical Engineers, Petroleum Branch, fall meeting, Elk's Club, Los Angeles, October 20-21.

Western Petroleum Refiners Association, regional technical meeting on waste-disposal problems, Palmer House, Chicago, October 21.

American Institute of Chemical Engineers, South Texas Section, annual meeting, Hotel Galvez, Galveston, October 21.

National Conference on Industrial Hydraulics, fifth annual meeting, Sheraton Hotel, Chicago, October 26-27.

Independent Natural Gas Association of America, annual meeting, Baker Hotel Dallas, October 31.

November

Society of Automotive Engineers, diesel, Chase Hotel, St. Louis, November 1-2.

Pacific Chemical Exposition, Civil Auditorium, San Francisco, November 1-5.

Society of Automotive Engineers, fuels and lubricants, Chase Hotel, St. Louis, November 3-4.

American Petroleum Institute, annual meeting, Stevens Hotel, Chicago, November 7-10.

Petroleum Electric Power Association, annual conference, Hotel Beaumont, Beaumont, Tex., November 17-18.

Society of Exploration Geophysicists, regional exploration meeting, Adolphus Hotel, Dallas, November 17-18.

American Society of Mechanical Engineers, annual meeting, Hotel Statler, New York, November 27-December 2.

December

American Institute of Chemical Engineers, annual meeting, William Penn Hotel, Pittsburgh, Pa., December 4-7.

Interstate Oil Compact Commission, annual meeting, Roosevelt Hotel, New Orleans, December 5-7.

NOMADS

Houston Nomads, second Monday of each month, Ye Olde College Inn, Houston.

Los Angeles Nomads, second Wednesday of each month, Jonathan Club.

Varied Topics Featured at Columbus A.I.M.E. Meeting

Topics of varied interest to members of the Petroleum Branch, American Institute of Mining and Metallurgical Engineers, have been scheduled at the organization's meeting in conjunction with the annual midyear meeting of A.I.M.E. at Neil House and Deshler-Wallick hotels in Columbus September 25-29 The Petroleum Branch's meeting is scheduled September 26-27.

The complete program follows:

September 26: "Improved Casing Cementing Practices in the United States," by W. D. Owsley, Halliburton Oil Well Cementing Co., Duncan, Okla.; "Ability of Drilling Muds to Lift Bit Cuttings," by H. N. Hall, Tulsa; Howard Thompson, Houston; and Frank Nuss, Fort Worth; all with Stanolind Oil & Gas Co.; "Dynamometer Charts and Well Weighing," by Leo Fagg, Johnson-Fagg Engineering Co., Tulsa.

September 27: "Applications of the Tefloodmeter to Water Flooding," by Quentin B. Marsh, Sperry-Sun Well Surveying Co., Crossville, Ill.; "Determination of Friction Factors for Measuring Gas-Well Productivity," by R. V. Smith, U. S. Bureau of Mines, Bartlesville, Okla.; "Reworking a Five-Spot Water Flood," by James Buckwalter, Ryder Scott Co., Bradford, Pa.; "Natural Gas—A New Giant," by J. French Robinson, president, East Ohio Gas Co., Cleveland; "Petroleum Research at Battelle," by Frank Croxton, Battelle Memorial Institute, Columbus; "Production of Synthetic Liquid Fuels from Oil Shale," by Walter R. I. Murphy, U. S. Bureau of Mines, Laramie, Wyo.; "Selective S. P. Logging," By Henri G. Doll, Schlumberger Well Surveying Corp., Ridgefield, Conn.; and "Radioactivity Well Log Interpretations," by John M. Terry, Lane-Wells Co., Oklahoma City.

Freight Rate Cut on Oil Granted by Mississippi

While most railroads are seeking higher freight rates on many commodities, rail carriers who sought reduction in freight charges on refined petroleum in Mississippi had their request granted by Mississippi Public Service Commission.

The 21 per cent reduction was sought by the railroads in order to meet competition in petroleum hauling by motor-freight lines. Opposition to the reduction was presented before the commission by a group of motor lines.

LEGAL

Department of the Interior, Wind River Indian Agency, Fort Washakie, Wyoming, September 9, 1949. Notice is hereby given that **SEALED BIDS** will be received until 2:00 P. M. October 7, 1949, and opened at that time in the Office of the Superintendent of the Wind River Indian Agency, Fort Washakie, Wyoming, for the leasing of the following unit of tribal land, located in Hot Springs County, Wyoming, for oil and gas mining purposes: UNIT NO. 1: SE¼ SE¼, Section 12; NE¼, Section 13, Township 8 North, Range 1 East, W.R.M. Lots 3 and 4, E½ SW¼, SE¼, Section 7; S½ Section 8; S½ SW¼, SW¼ SE¼, Section 9; SW¼ SW¼, Section 14; SW¼, S½ NW¼, W½ SE¼, SE¼ SE¼, Section 15; all of Sections 16 and 17; Lots 1 and 2, E½ NW¼, NE¼, NE¼ SE¼, Section 18; NE¼, NE¼ NW¼, Section 20; all of Sections 21 and 22; W½, W½ NE¼, SE¼, Section 23; W½, NE¼, Section 26; N½, Section 27; N½ NE¼, Section 28; N½ NW¼, Section 35, Township 8 North, Range 2 East, W.R.M. containing 5980.83 acres. The foregoing unit of tribal land is being offered as a single unit, and a lease will be drawn on the applicable Government form. The right is reserved to reject any and all bids. The successful bidder will be required to pay the cost of the advertisement. The lessee must pay as advance rental $1.25 per acre per annum. The lease will be sold to the highest bidder for a bonus offer upon an acreage basis in addition to the royalty of 12½%. The successful bidder must deposit with the Superintendent of the Wind River Indian Agency, on the date of the sale, a certified check or bank draft on a solvent bank in an amount equal to 20% of the bonus bid and of the first year's rental, as a guaranty of good faith. The check is to be made payable to the TREASURER OF THE UNITED STATES. The lessee will be required to use diligence in drilling and producing operations and shall commence the drilling of a test well within one year from date of approval of the lease and diligently continue drilling to test to the satisfaction of the U. S. Geological Survey the oil producing possibilities of the Madison formation unless oil or gas in commercial quantities is found at a lesser depth or the U. S. Geological Survey shall determine that further drilling in the well would not be warranted. The lease must be completed and filed with the Superintendent within 20 days from the date it is received by the lessee for execution and returned with the remainder of the bonus bid, the balance of the first year's rental, and a filing fee of $10. Failure in any of these conditions may subject the bid to cancellation without further notice and forfeiture of payments already made. The lease on the above tribal unit will be drawn pursuant to the Act of May 11, 1938 (52 Stat. 347) and the regulations, Part 186, Title 25, C.F.R. The lease issued pursuant to this notice will be made for a term of 10 years from the date of approval by the Commissioner of Indian Affairs and as long thereafter as oil and/or gas is produced in paying quantities. The rate of royalty will be 12½% of the value of all oil, gas and/or natural gasoline, unless the lessor, with the approval of the Commissioner of Indian Affairs, elects to take royalty in kind. The adequacy of the bonus offer will be determined by the U. S. Geological Survey. A suitable bond will be required, and such bond must be approved by the Commissioner of Indian Affairs. The responsibility of complying with any requirements of the Federal Documentary Stamp Statutes will be left with the successful lessee. All bids should be addressed to the Superintendent, Wind River Indian Agency, Fort Washakie, Wyoming, in a plain envelope marked: BID FOR OIL AND GAS MINING LEASE, EMBAR AND WEST MUD CREEK ANTICLINES, TO BE OPENED AT 2:00 P. M., OCTOBER 7, 1949. For further information call or write the Land Division of the Wind River Agency J. M. Cooper, Superintendent.

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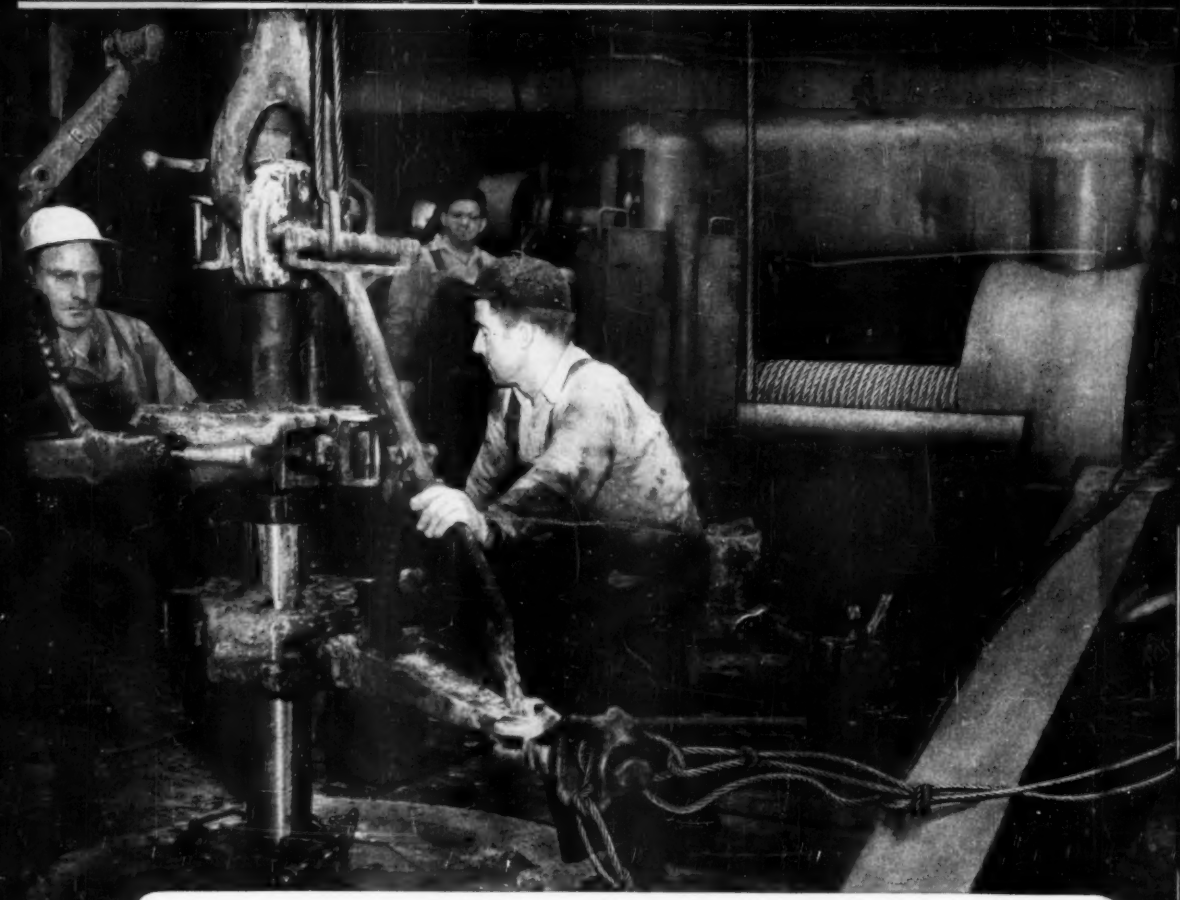

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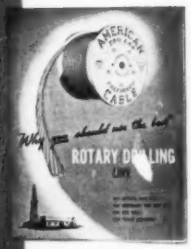

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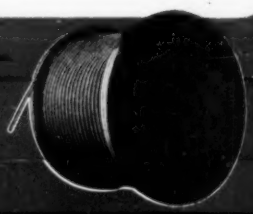

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